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The Electrical Age.

Established 1883.

An Illustrated Weekly Electrical Journal.

10 cents per copy

VOL. XXII - No. 581

NEW YORK, JULY 2, 1898.

Subscription, \$2.50 per year.
Foreign Countries, \$3.50 per year

1889.

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RUBBER INSULATION.



1893.

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INSULATION.

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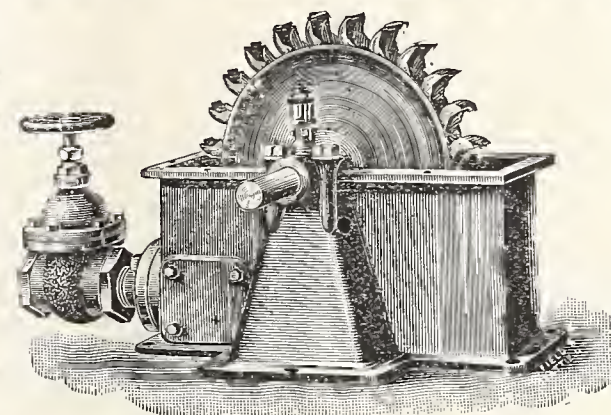
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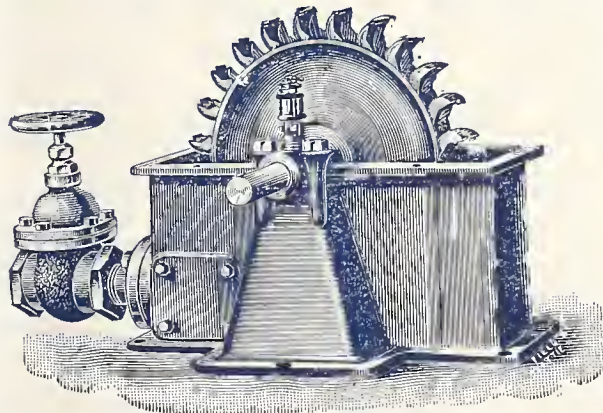
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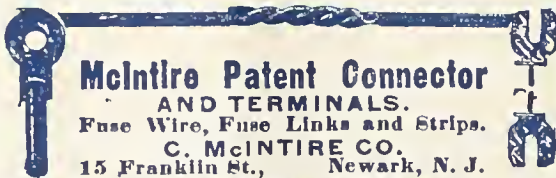
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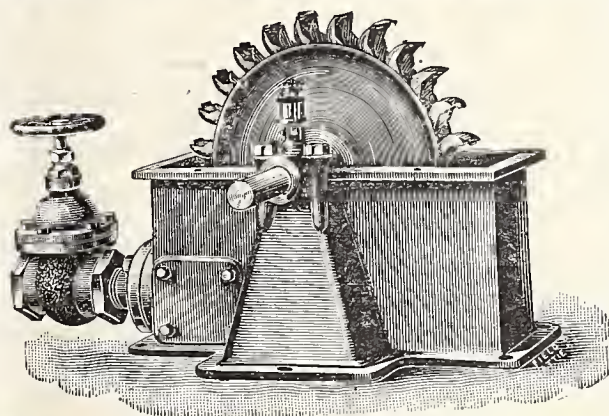


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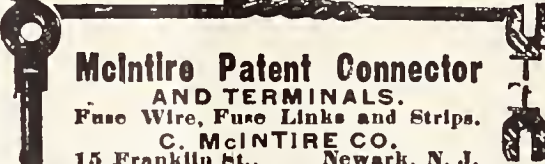
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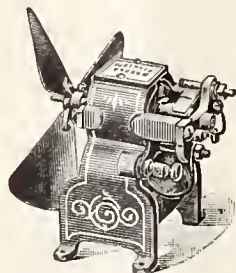
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10 cents per copy

VOL. XXII.—No. 585.

NEW YORK, JULY 30, 1898.

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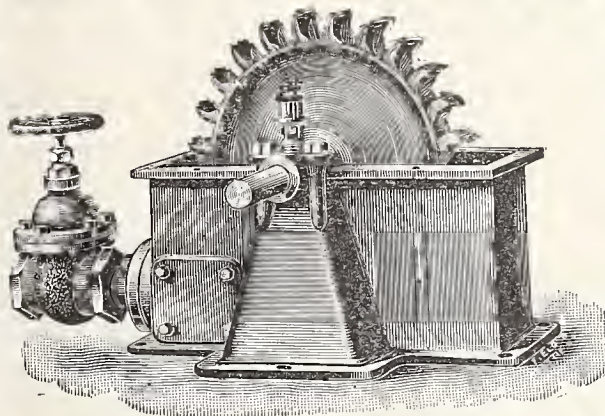
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VOL. XXII.—No. 586.

NEW YORK, AUGUST 6, 1898.

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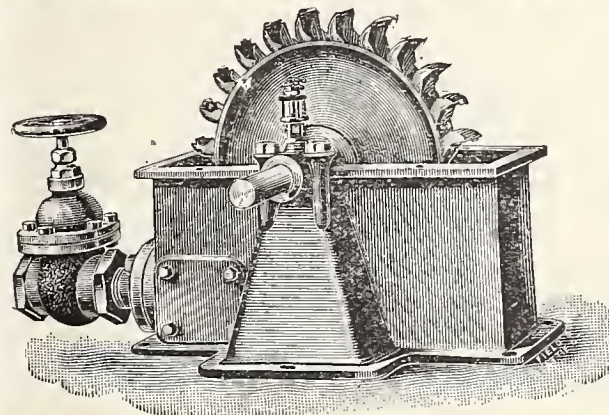
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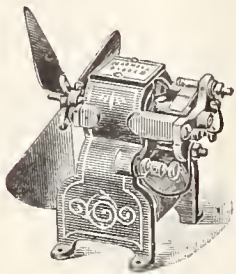
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OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

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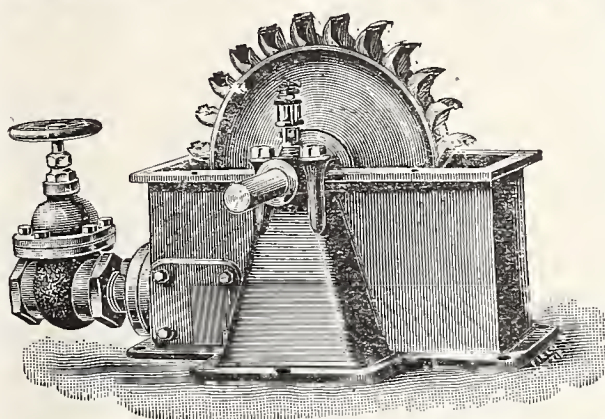
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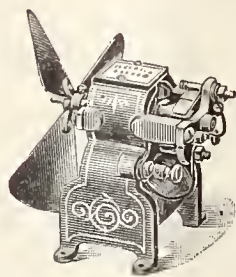
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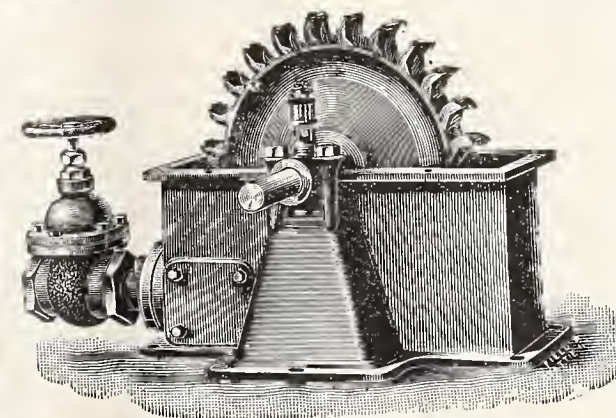
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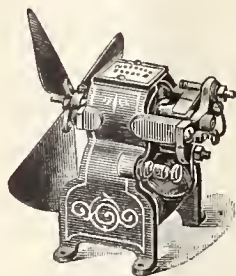
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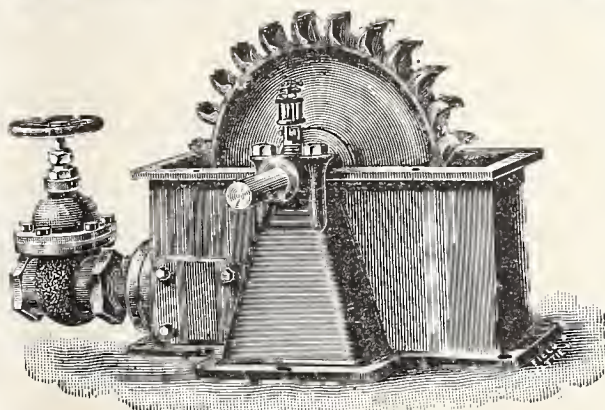


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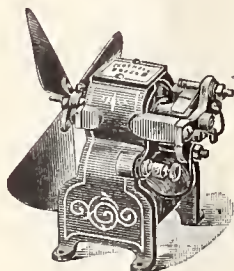
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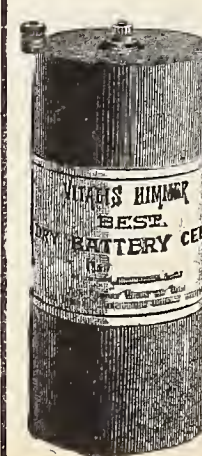
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10 cents per copy.

VOL. XXII.—No. 590

NEW YORK SEPTEMBER 3, 1898.

Subscription, \$2.50 per year
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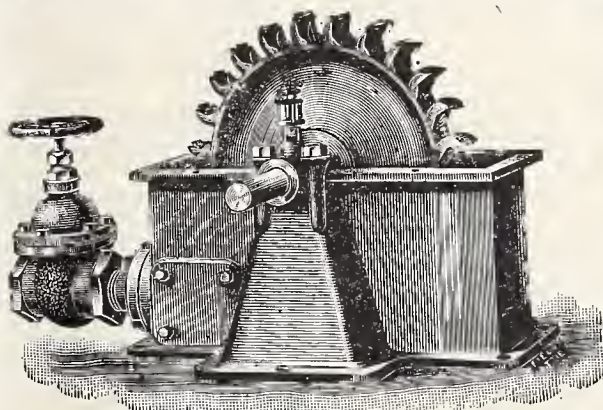
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VOL. XXII. --No. 591.

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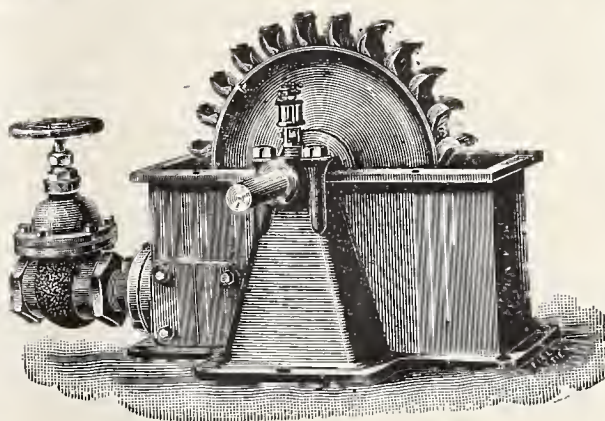
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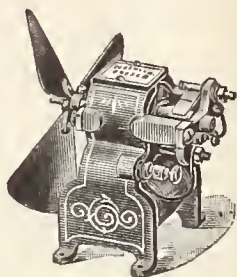
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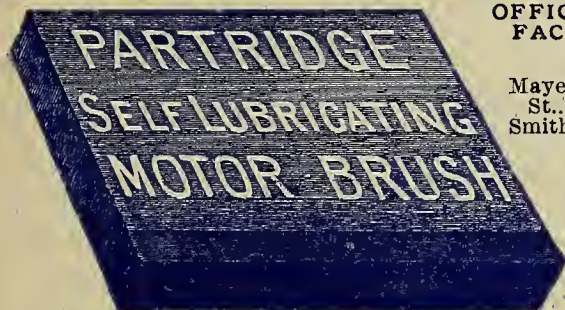
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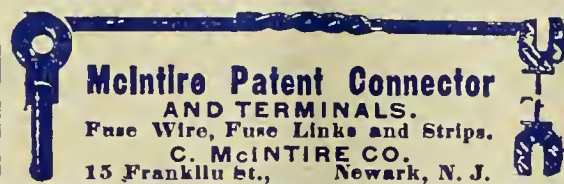
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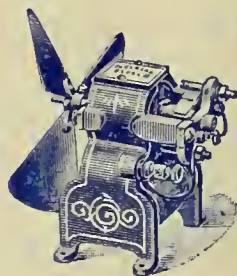
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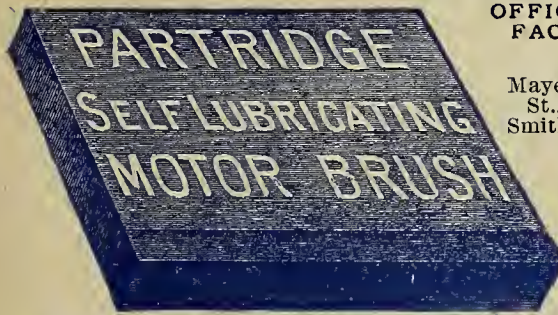
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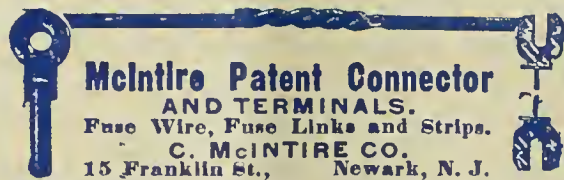
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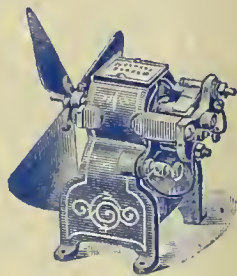
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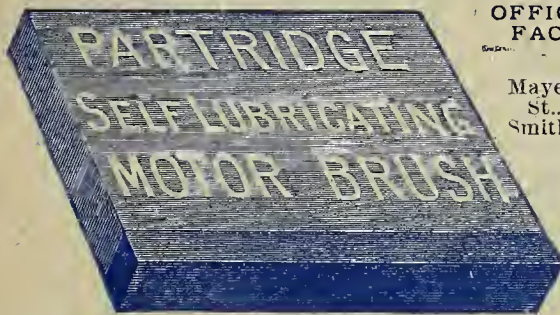
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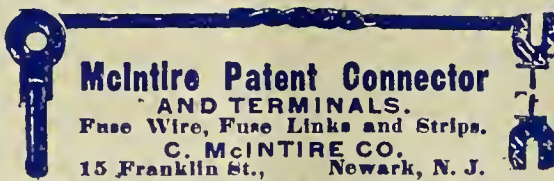
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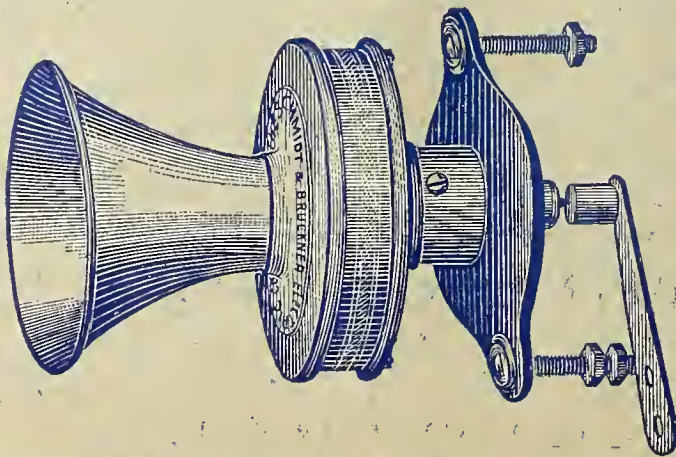
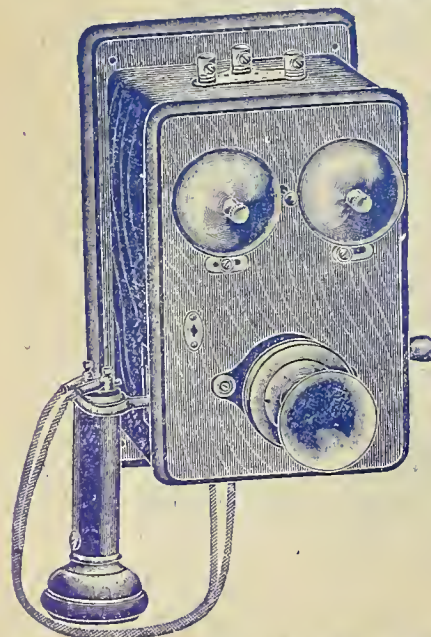
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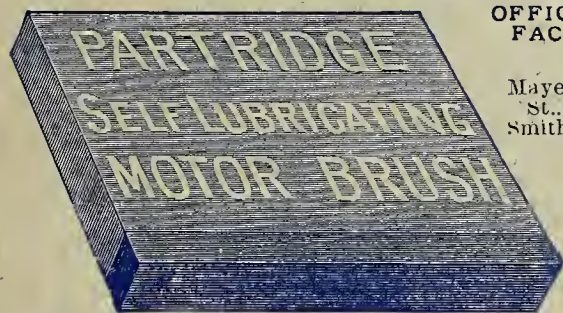
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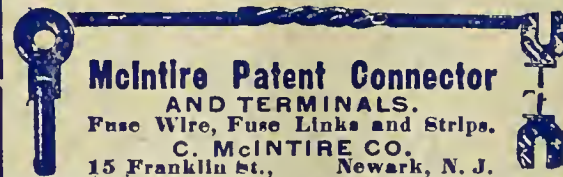
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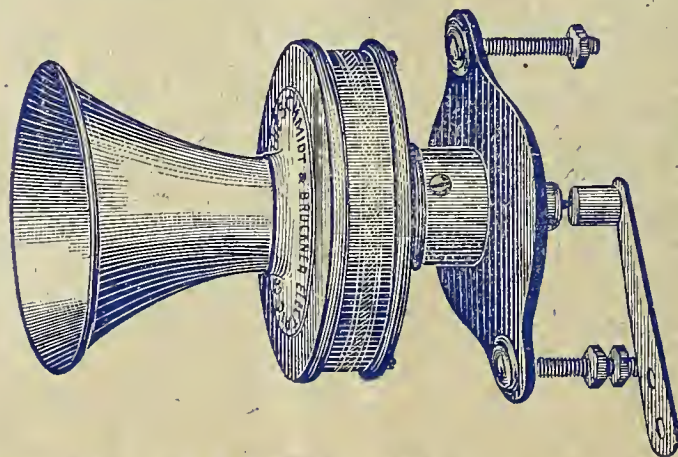
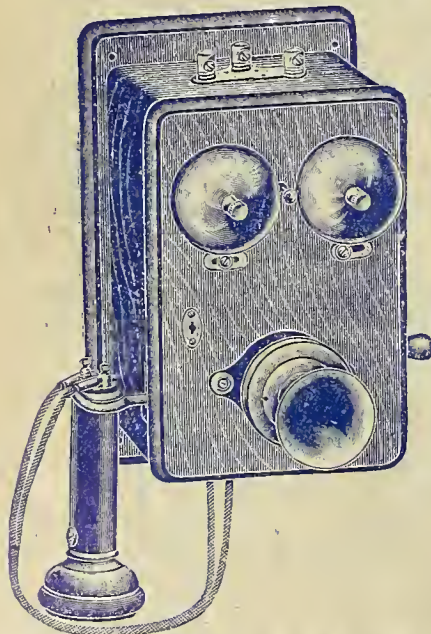
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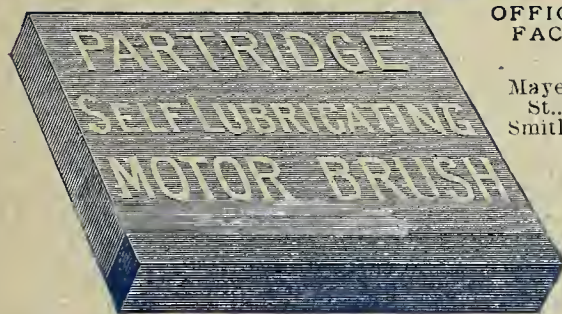
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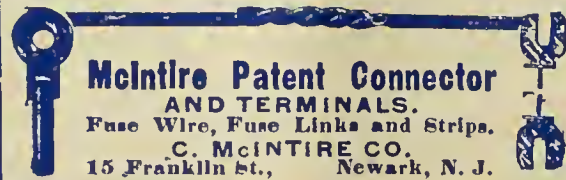
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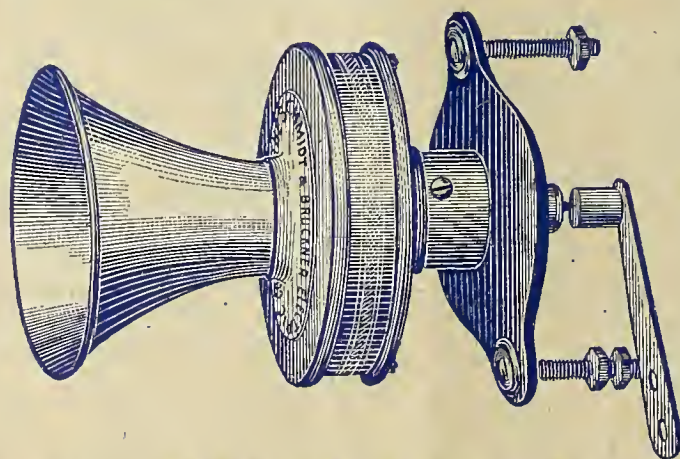
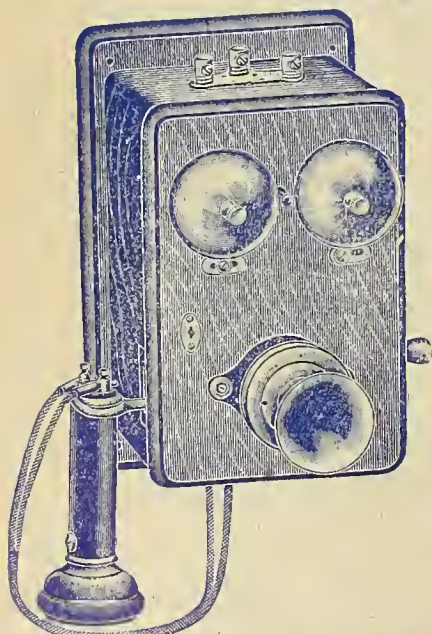
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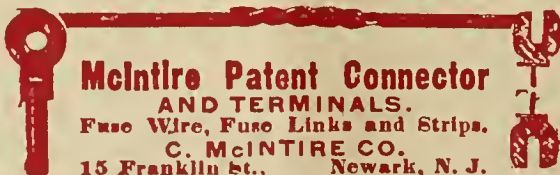
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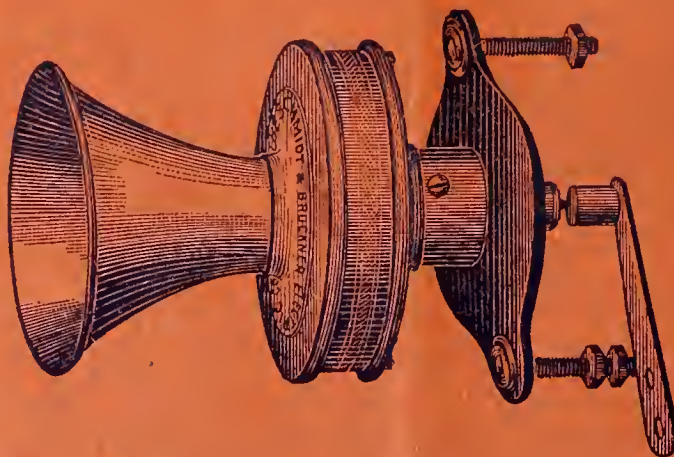
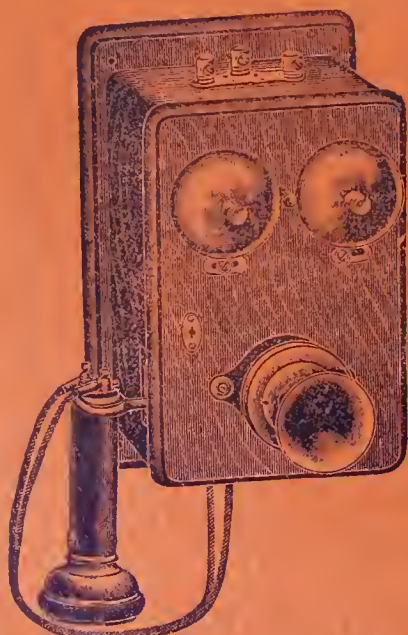
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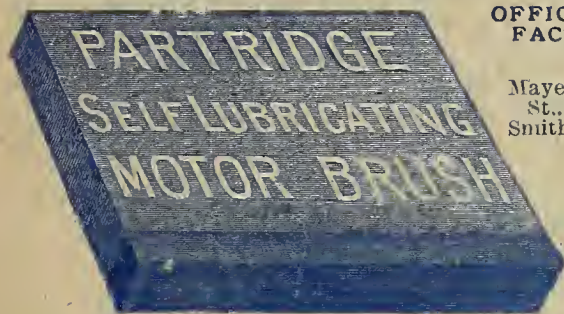
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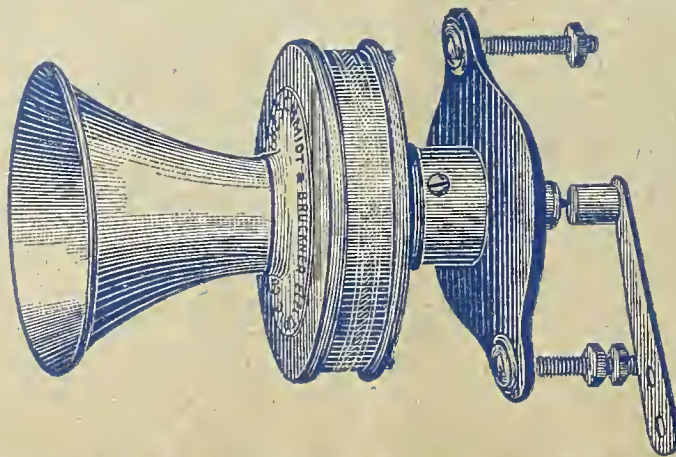
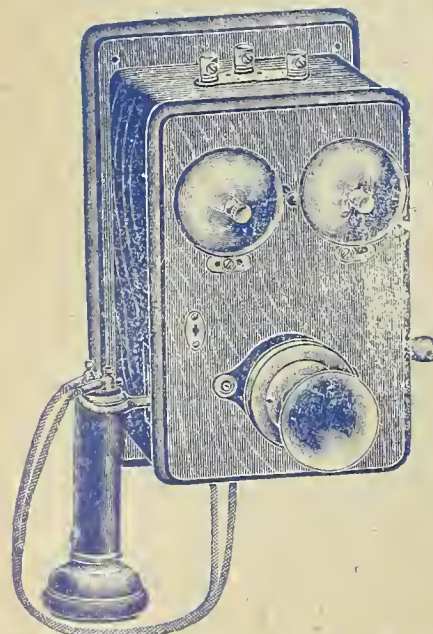
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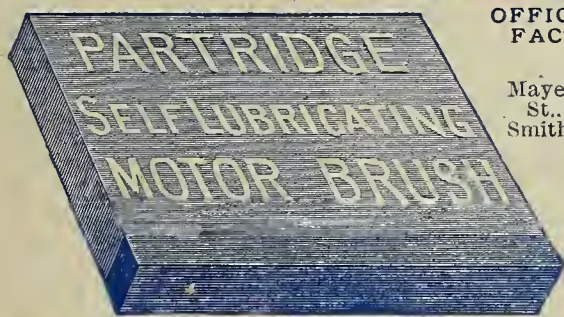
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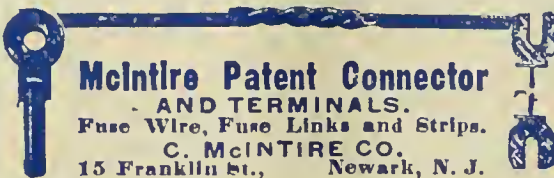
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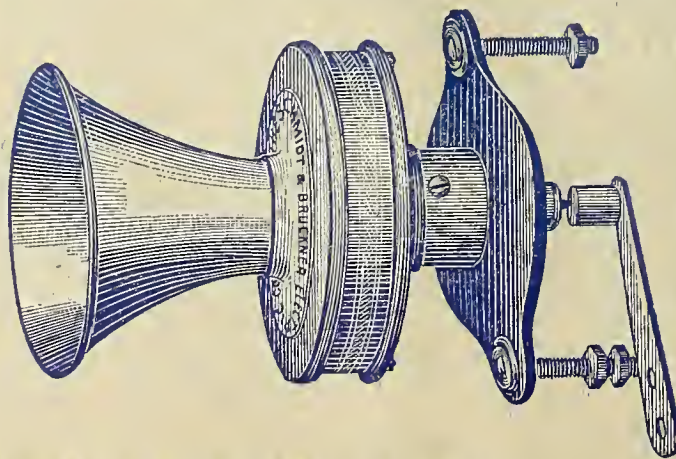
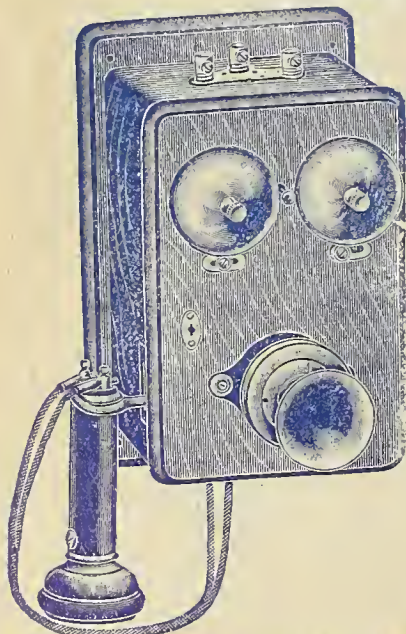
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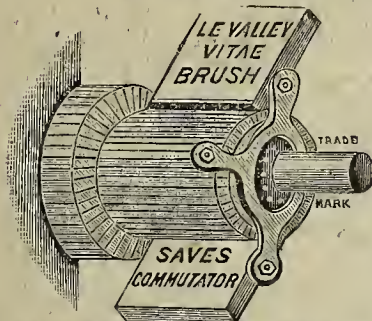
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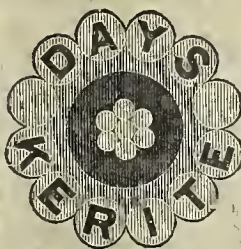
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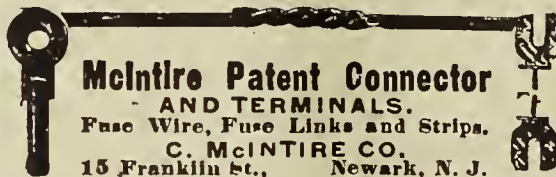
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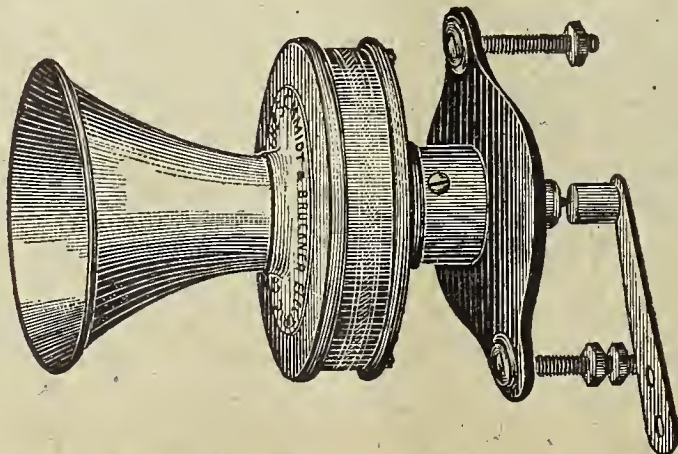
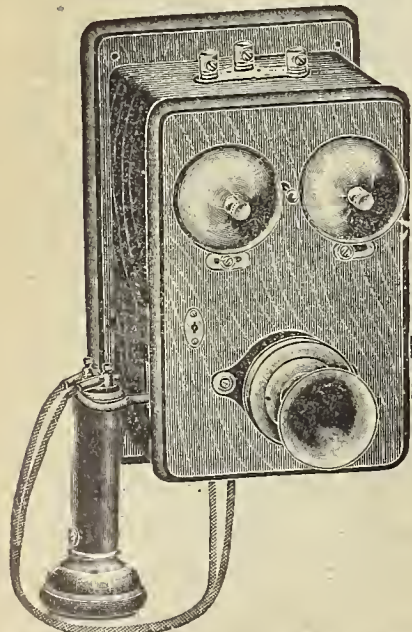
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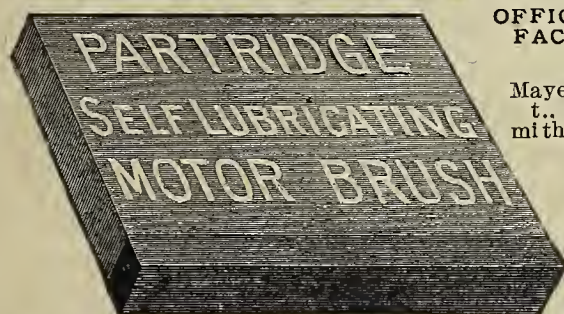
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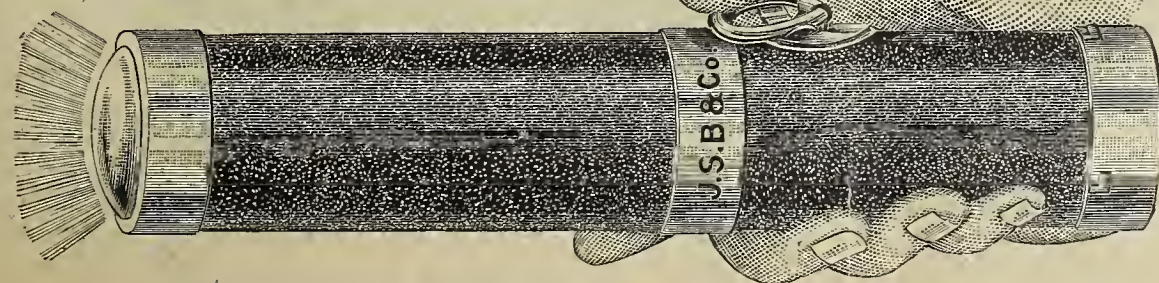
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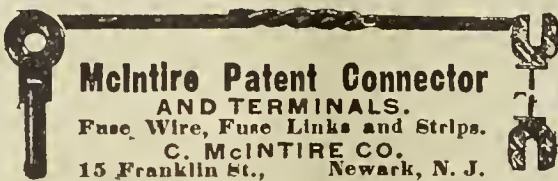
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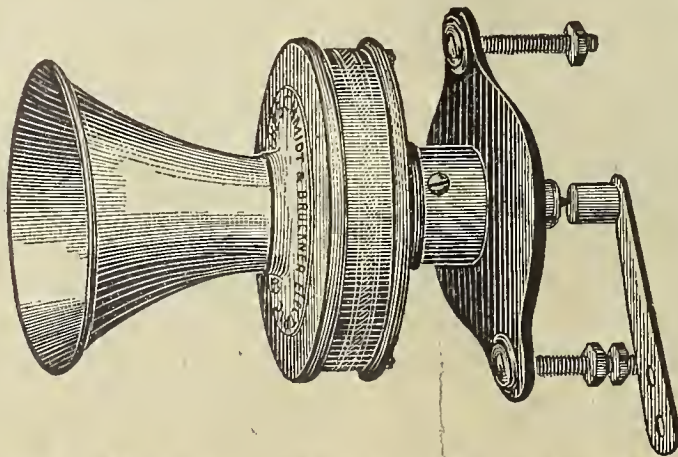
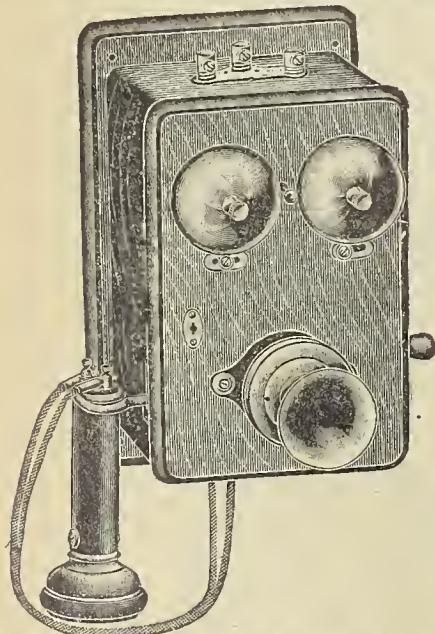
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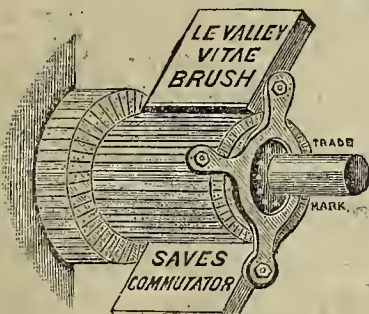
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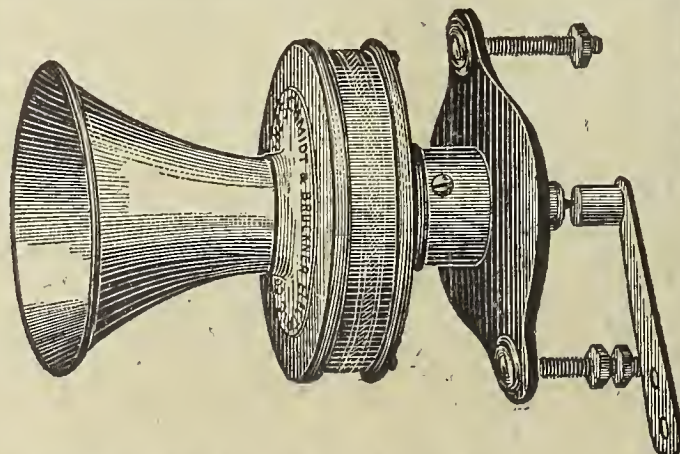
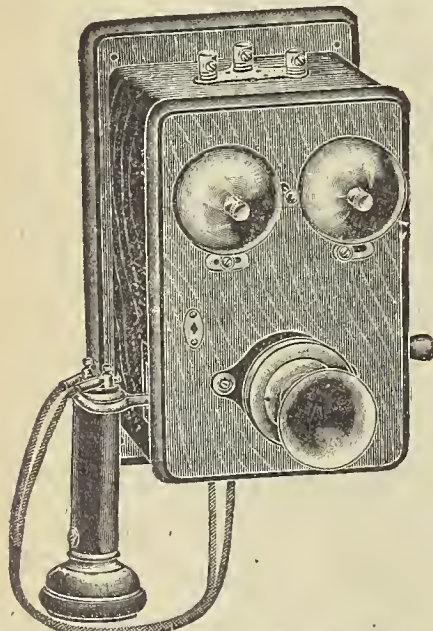
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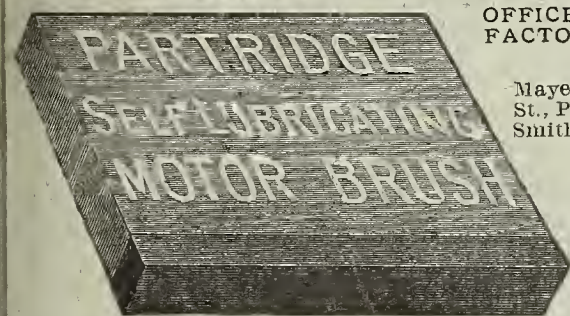
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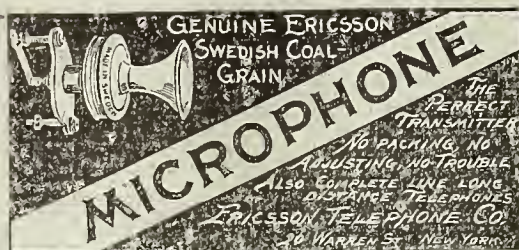
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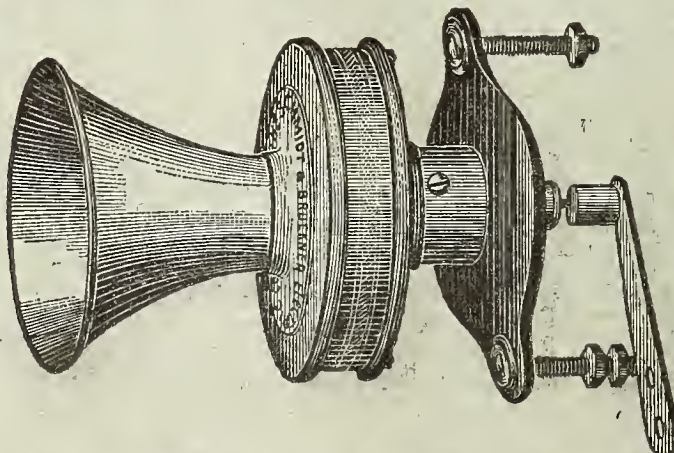
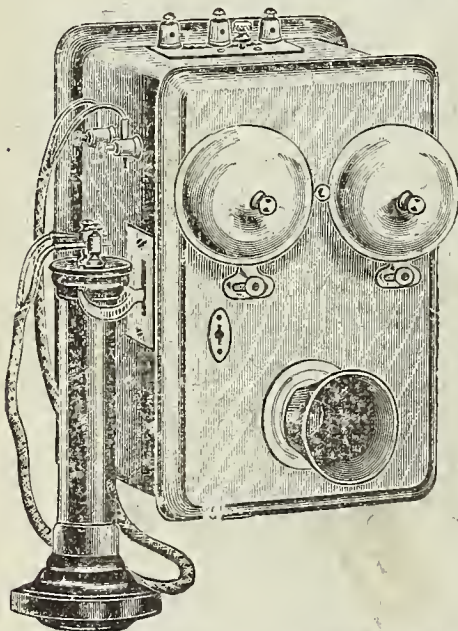
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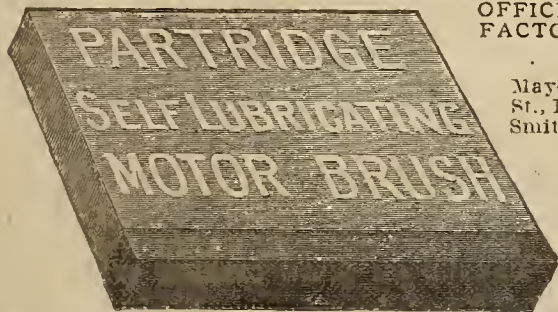
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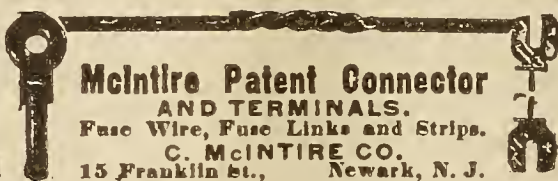
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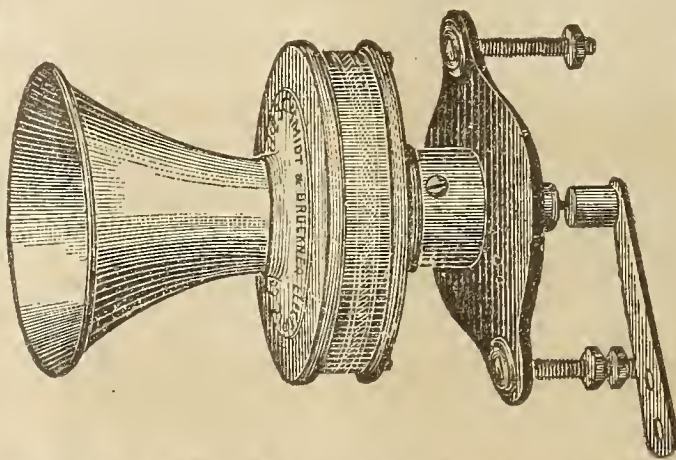
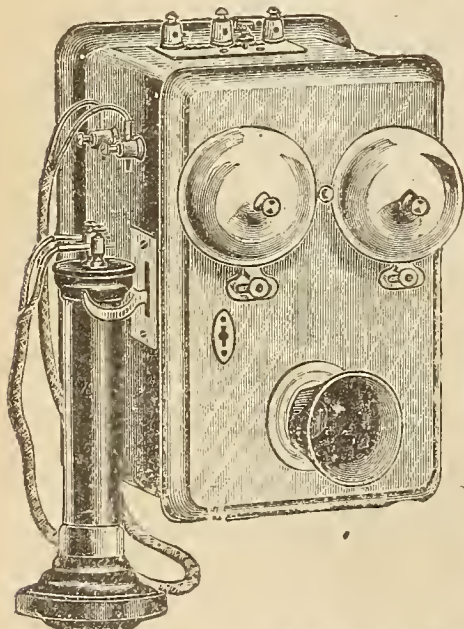
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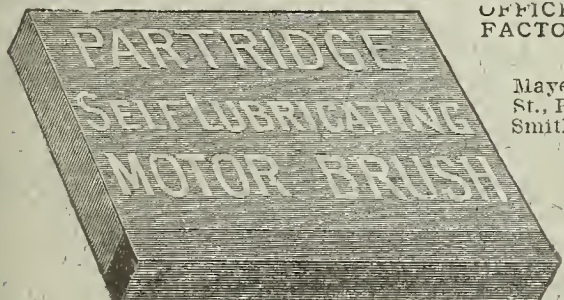
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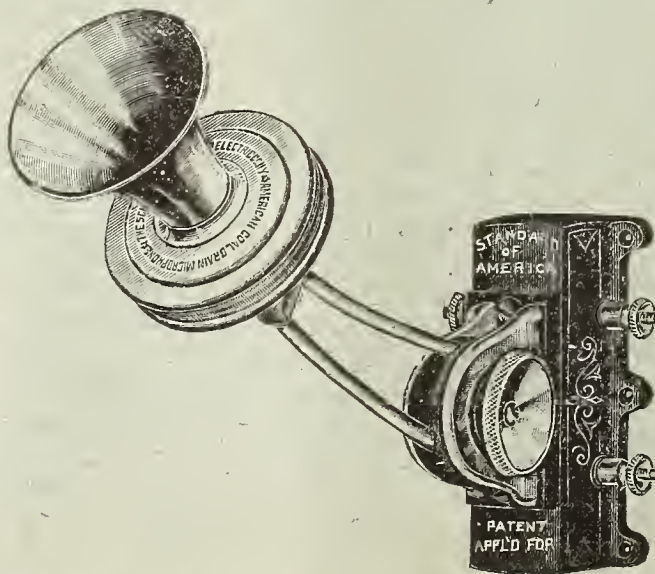
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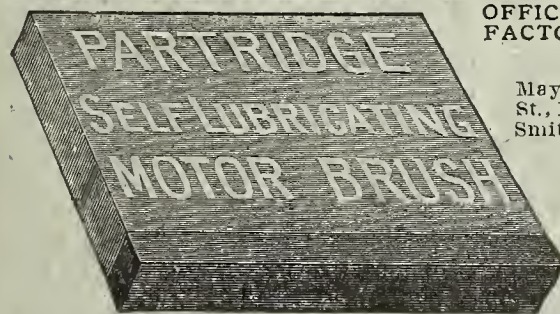
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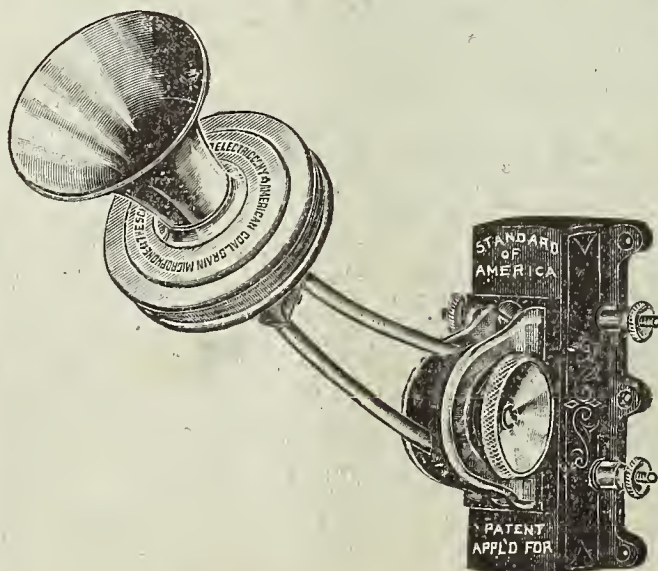
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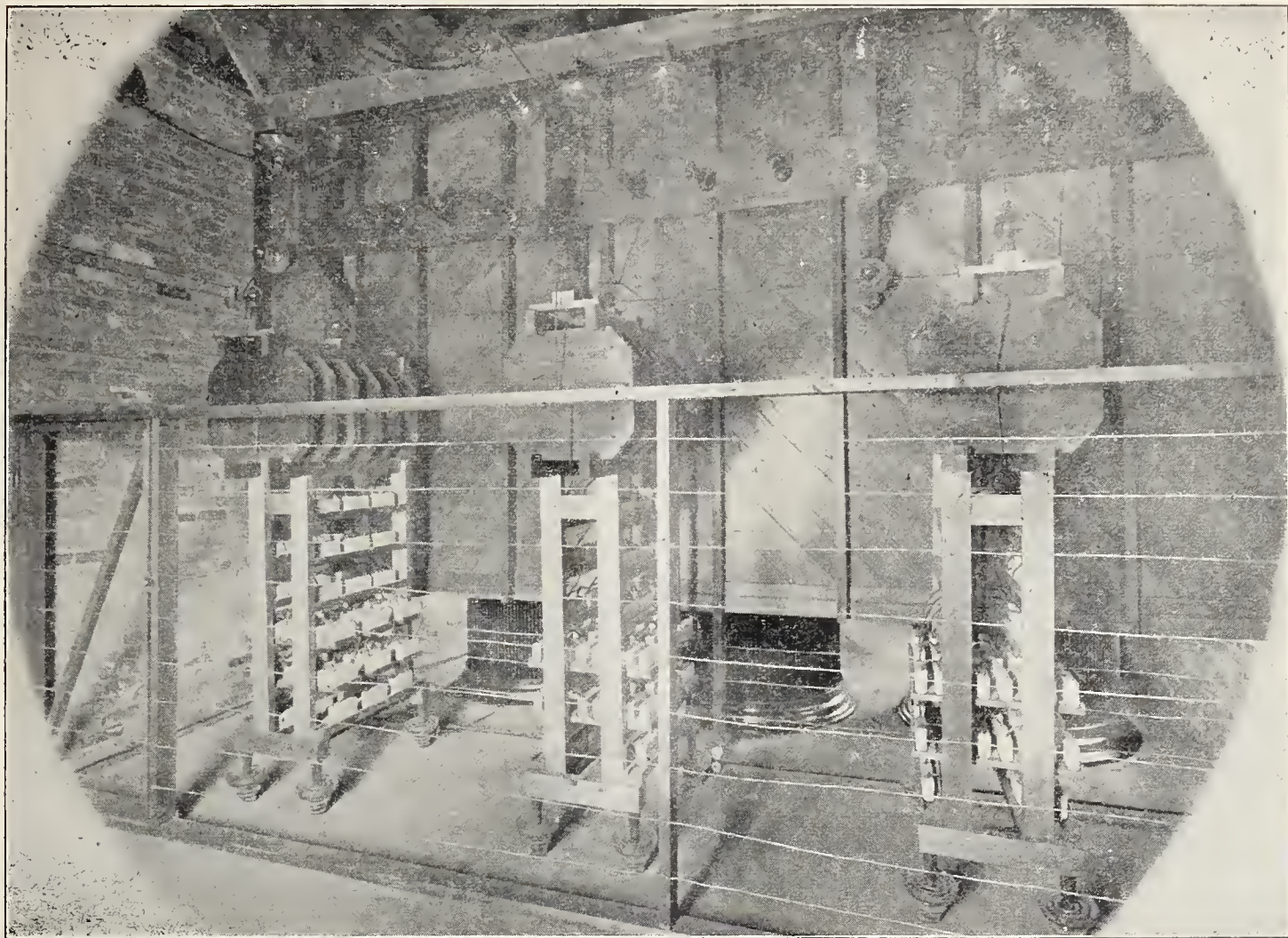
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The Electrical Age.

VOL. XXII—No. 1

NEW YORK, JULY 2, 1898

WHOLE No. 581



Lightning Arresters in High Tension Room, Golden Gate Mill, Utah.

ELECTRIC POWER AT THE GOLDEN GATE MILL, UTAH.

*(Through the courtesy of the Engineering and Mining
Journal.)*

The largest cyanide mill in the world, the Golden Gate, at the Mercur mines in Utah, is operated by electric power, which is transmitted from the generating plant, a distance of 35 miles, to Mercur, at a potential of 40,000 volts. The entire outfit is of Westinghouse manufacture, and exemplifies the high development that has been made in the construction of machinery for long-distance power-transmission enterprises. The Telluride Power Transmission Company supplies the power, which is transmitted in three phases to the Golden Gate mill. This is situated at the entrance to the mines, 35 miles southwest of Salt Lake City, at the terminus of the Salt Lake & Mercur Railroad. The town of Mercur is the business centre of the Camp Floyd mining district, and the Golden Gate mill represents the most extensive application of the cyanide process to the ores of that region. The capacity of the plant is over 500 tons of ore per day.

The mill is a steel structure, situated on the side of a steep hill, which was blasted so as to obtain level spaces of sufficient width to provide a foothold for the foundations. Provision has been made for minimizing the labor of conveying, by allowing the ore to start at the top of the hill and proceed by gravity from each level to the next below in the course of the different processes of treatment. The buildings cover 4 acres, being 294 ft. in width along the side of the hill, and 420 ft. in length up and down the slope. The difference in vertical height between the upper and lower ends of the mill is over 400 ft. The buildings are shown in the illustration, Fig. 1,

which gives a view of the entire plant. The mines, not shown in this figure, are situated below the part of the slope that appears in the illustration. There are eight levels in the mill proper. The loose stone produced in blasting out these levels was used in building the foundations and retaining walls. These walls are 2 ft. wide at the top, and have a batter of 1 in 12. They comprise over 5,000 cu. yds. of rubble masonry, laid in lime mortar. The structural steel work of the building contains over 2,400,000 lbs. of metal.

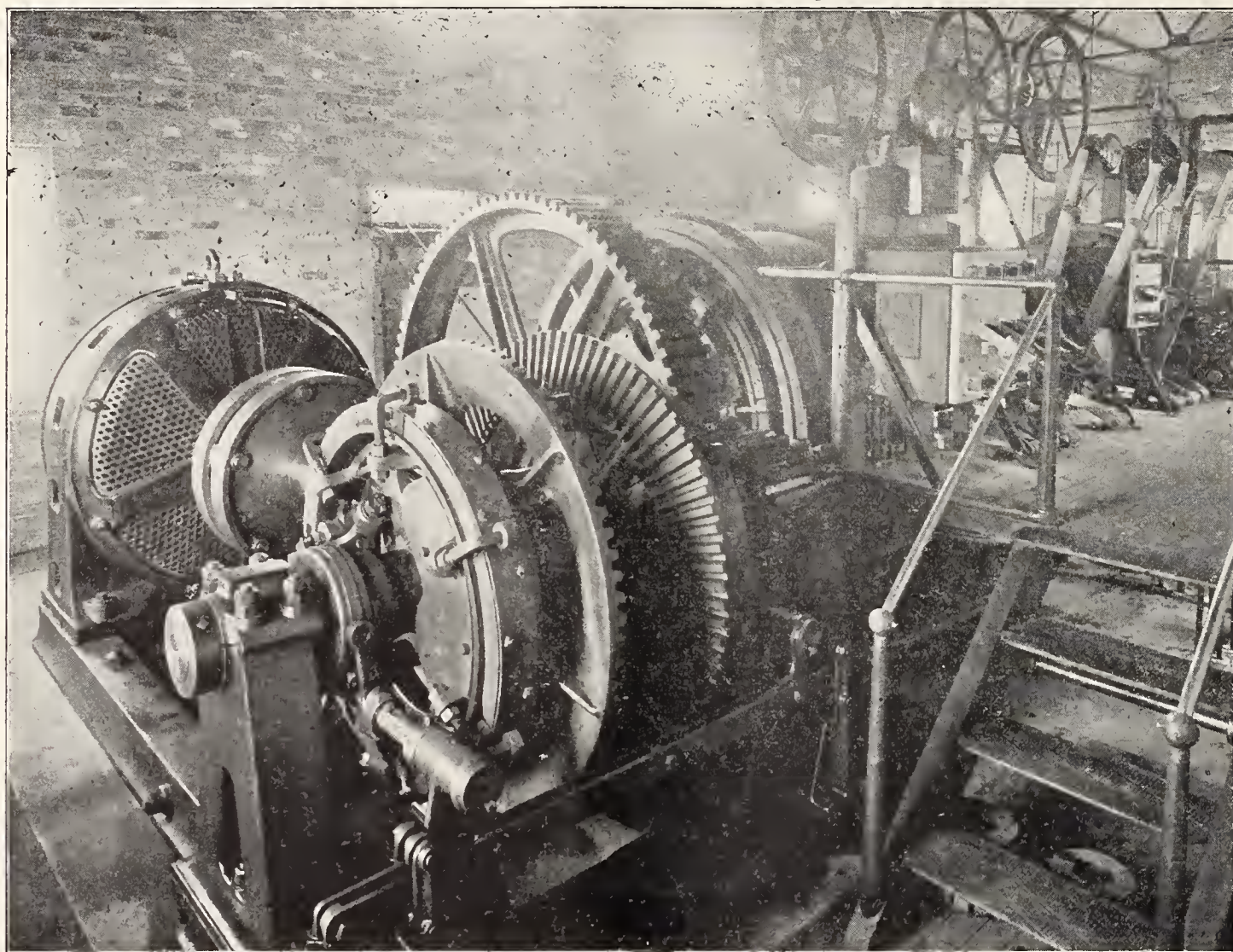
The installation of the motors was in charge of the Mountain Electric Company, of Denver, Colo., under the supervision of Messrs. Nunns, the general contractors.

In the transmission of power to Mercur, the loss of electric energy is extremely low, being scarcely 5 per cent. In that dry region, high potential lines require but little attention, and wastes are reduced to a minimum. Current is delivered to the mine at \$60 per H. P. per year, with a minimum consumption of 300 H. P. stipulated. The transformer house, which contains the apparatus for converting the current from 40,000 volts, three-phase, to 220 volts, two-phase, is located between the shaft house and the mill. A view of the interior of the high-tension room is given in Fig. 2, which shows the general arrangement of the Wurts lightning arresters and high-tension lines.

The ore is hoisted from the shaft on an incline to the crusher situated at the top of the hill, a distance of 800 ft. This first, or upper, story of the mill is devoted to the coarse crushing of the ore, and is 25 ft. wide by 75

ft. long, the height being 100 ft. It is divided into three floors. The upper floor receives the ore in bins, just as it comes from the shaft. The middle floor contains the

This entire upper story is divided vertically into three chutes or compartments for the different kinds of ores—talc, silicious, and arsenical—which are kept separate

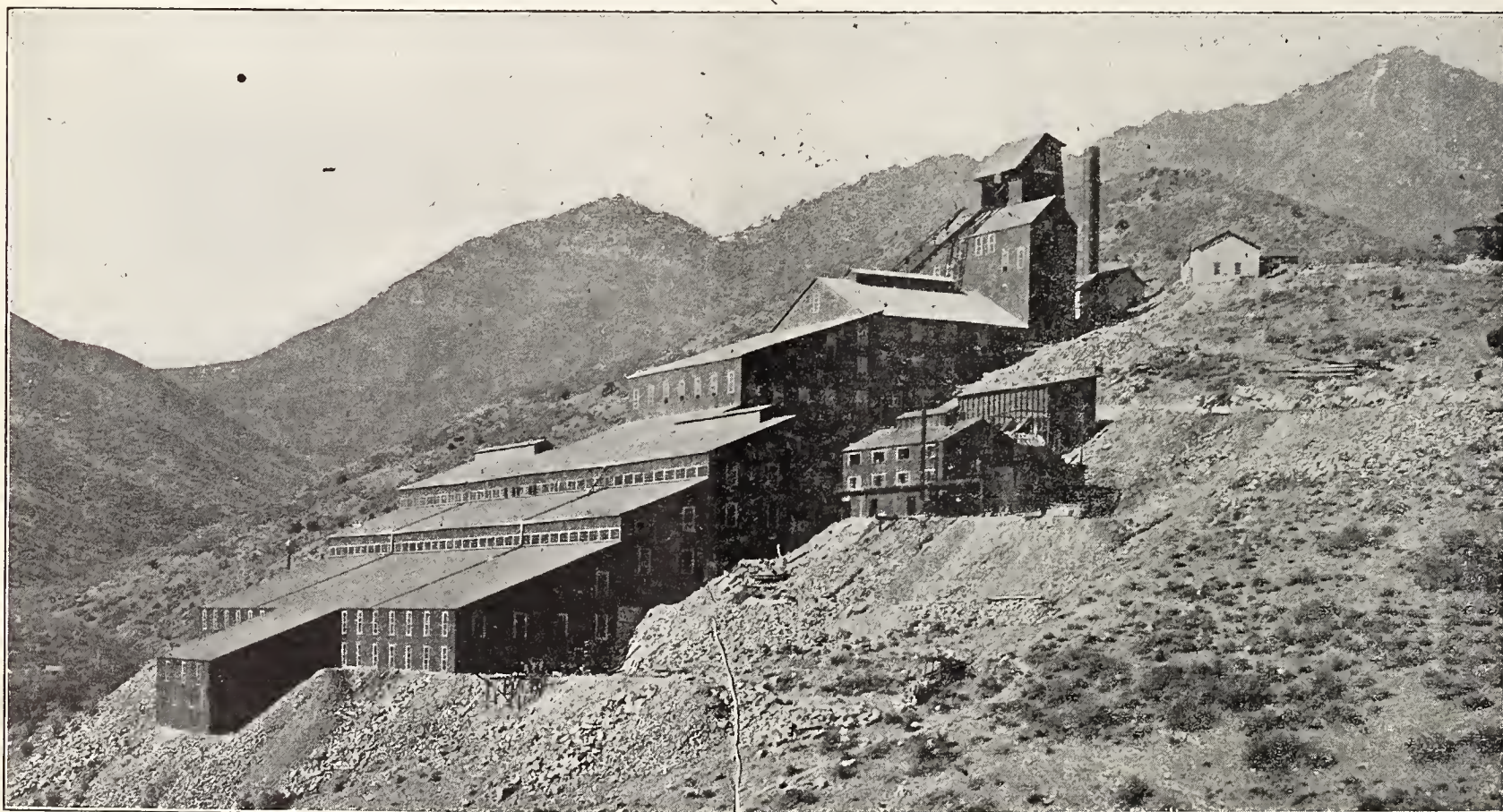


Motor Coupled to Hoist, Golden Gate Mill, Utah.

crushers, weighing 20 tons each, and having a combined capacity of 1,500 tons daily. They are operated by two 50 H. P. Westinghouse type C motors. From the crusher

through the mill until they are finally mixed for the leaching tanks.

The second section of the mill contains two dryers,



Golden Gate Mill, De La Mar's Mines, Mercur, Utah.

floor the ore is lowered to the third level of the upper story, where it is stored in bins of 2,000 tons capacity,

having a capacity of 500 tons per day, room being left for another dryer, in case the plant should be enlarged. The

ore is worked over the floors of the dryers by rabbling devices operated by endless chains, and is there heated for about $2\frac{1}{2}$ hours. In the third section the fine crushing and ore sizing is carried on. The machinery consists of four sets of 26 in. and three of 36 in. Cornish rolls, with a maximum crushing capacity of 1,000 tons per day; Berthelet apparatus for sizing; and a system of elevators for raising the crushed product to the separators. Six elevators are used, two to each of the three different classes of ore, and their lift is 60 ft. There are three separators for each class, that which is sufficiently fine passing through to the next section, while that which is still coarse is passed through the crushers until fine enough. The pulverized ore is finally collected in an ore-bin holding 2,000 tons. Under this ore-bin is a dust chamber, which is connected directly with the main flue, and is provided with hoppers spaced 12 ft. apart. The floor is so arranged that the dust collects at the mouths of these hoppers to be drawn off into the cars below.

The roasting of the ores takes place in Sections 4, 5 and 6. Four straight-line furnaces are used. The arsenical ores are crushed to about 10 mesh and discharged into two of the furnaces. The talcy ores are crushed to 4 mesh and roasted in the remaining furnaces. The silicious ores do not require roasting, but are emptied directly into the receiving hoppers below the roasters and mixed with the other ores while there, in proper proportions for the leaching tanks. The four roasters are contained in Sections 4 and 5, Section 6 being reserved for a possible future addition. The furnaces used for the arsenical ores have a daily capacity of 75 tons each; those for the talcy ores of about 150 tons each. The furnaces have their roasting hearths directly on the foundations, the calcined ore being elevated to the cooling floors above. The ore is stirred during roasting by means of V-shaped plows or scoops attached to rabbling carriages. These consist of I-beams mounted on wheeled carriers which run on tracks on either side of the furnace hearth. They are driven by endless cables, and are spaced 75 ft. apart, the cables running on sprocket-wheels. The ore is stirred and advanced by these motor-operated cables once each minute. One man attends to two furnaces. The gases are carried from the furnaces through 6 by 8 ft. flues into the main dust chamber, which runs from this section to a steel stack 8 ft. in diameter and 85 ft. high, located on the hill above the buildings.

From the furnace hoppers the ore passes through a tunnel to a point just above the tanks on the seventh section of the incline. This section has two floors, the main floor containing 10 tanks, each 25 by 50 ft. and 5 ft. deep, and three solution tanks, 20 ft. in diameter and 12 ft. high. The tanks are supported by masonry piers and a retaining wall. The ore from the tunnels is received in cars and run out by hand over the tanks, where it is dumped. The solutions filter through the bottom of the tanks, passing out to the precipitating tanks on the eighth level. When the liquor has been drawn from the tanks the tailings are carried out on cars which run from underneath the tanks to the waste dumps.

In the eighth or lowest section the gold is precipitated from the cyanide solution, drawn off from the leaching tanks, in three vats 14 ft. in diameter by 8 ft. high, containing zinc turnings.

The works contain, in addition to the departments already mentioned, a machine shop, warehouse, gas plant (in which water gas is produced for roasting and drying the ore), assay office, refinery and chemical laboratory.

About 100 ft. above the mill, the power-house, a one-story brick building, 25 by 70 ft., is located. Here are placed the Westinghouse motors for operating the hoist and motor-driven air compressors for the machine drills in the mine below. An electric hoist of 150 H. P. operates the cages for the ore in the two compartments, and one of 75 H. P. operates the cage in the manway. In addition to the above purposes, Westinghouse motors are

employed for the main shaft blowers, centrifugal pumps, assay department, etc. The plant is operated entirely by two-phase induction motors, aggregating 700 H. P., all of the Westinghouse type C. The interior of the hoist room is shown in Fig. 3, with the large hoist. The hoists are direct-connected to 150 and 75 H. P. motors. There is also installed in this room a 150 H. P. motor direct-connected to an air compressor.

A 50 H. P. motor is used in driving the main shafting in the mill, while another of the same size drives the shaft for the roasters and the ore conveyor. The pump in the precipitation room is driven by a 20 H. P. motor. All motors are operated on a 24-hour load, and have been running continuously for the past two months.

The cost of the mill and equipment was about \$400,000. The mine was described in the "Engineering and Mining Journal" for April 24th, May 1st and July 31st, 1897. At the time the Golden Gate mill was erected, some doubt was felt as to whether the electrical machinery would be found adequate for the heavy work of the plant. It has turned out, however, that the electrical apparatus is the most trustworthy and reliable part of the equipment. If a crusher becomes clogged, it is usually the case that a belt or gear will give way before the motor becomes stalled.

A NEW PROCESS OF COLORING LEATHER BY THE AID OF ELECTRICITY. — A modification of the ordinary brushing process has recently been introduced in Germany, quotes the Textile Journal of Bombay, and in this method of dyeing the zinc-covered table upon which the hide or skin is placed forms the positive pole for the generation of an electrical current for inducing a certain reaction. The fluid dyeing material is poured upon this table, and the negative pole is then connected to the leather. Under the action of the current, the coloring matter penetrates the immediate surface of the leather, and the intercellular fixation and distinction is said to leave nothing to be desired. Patterns may be made upon the leather by covering it with an ordinary stencil system, and on connecting these plates to the negative pole, the desired representations are formed.

FRANK J. SPRAGUE GETS A FAR-REACHING DECISION AGAINST NASSAU COMPANY. — Justice Lacombe, sitting in the United States Circuit Court for the Eastern District of New York, yesterday handed down a decision which will cost the Nassau Electric Railway Company a million dollars in money, and which may, in the process of its going into effect, materially interfere for a time with the ability of the Nassau lines to render schedule service.

The decision was on a motion of Joseph P. Ord, et al., assignees of certain patents granted to Frank J. Sprague, covering the form of electric motor used on nearly all the cars of the Nassau lines. The motion asked for an injunction to stop the infringement of Sprague's patents by the defendant company.

Judge Lacombe granted the injunction asked, and orders the Nassau Company to remove the motors now used to propel its cars. The order provides that 250 motors shall be removed within thirty days from the date of the order's issuance; 250 more within sixty days and all remaining motors within 120 days. — Ex.

EFFECT OF ARMATURE INDUCTANCE UPON THE ELECTROMOTIVE FORCE CURVES OF AN ALTERNATOR.

(Concluded from page —.)

Over-Compounding.

It was noticed during the test that the armature reaction caused an increase in the total effective potential for certain ranges of load.

This phenomenon has been noted by other writers, and in his paper before the Institute, already referred to, Steinmetz has pointed out an explanation for it. Curve A of Plate 17 is the external characteristic of the dynamo, with constant field excitation, and coils 1 and 2 alone in action. The curve was plotted from the readings of a Weston voltmeter and a Siemens dynamometer

the M. M. F. of the coils is purely a local one, and the paths traversed by the flux which it induces are confined to the air-gaps, poles and armature core. The influence of the armature inductance upon the flux density in the cores of the field spools is negligible, as a careful exploration established the fact that the field current was perfectly constant.

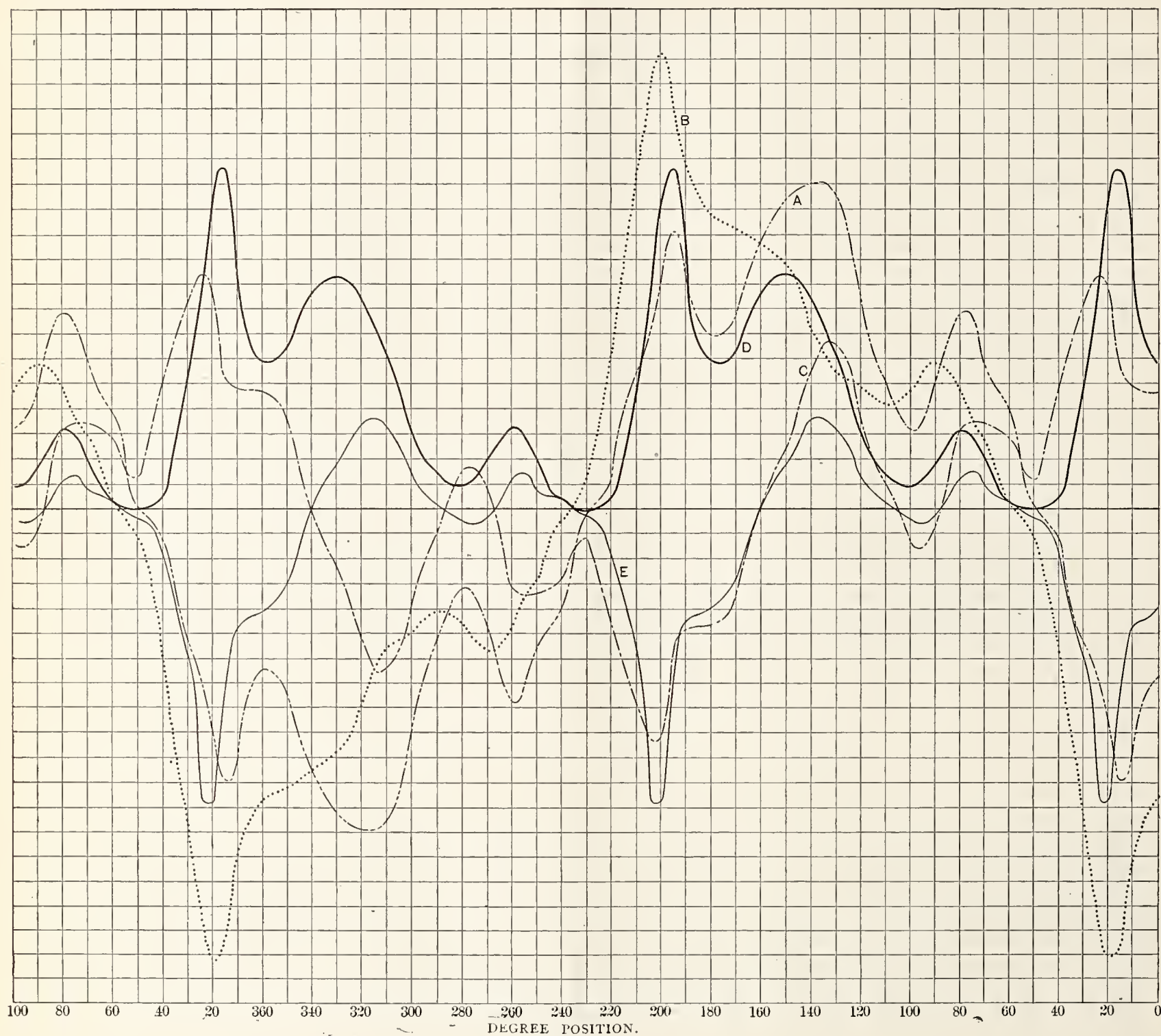


Plate 18.

- A = Fundamental E. M. F. wave.
- B = Total effective E. M. F. curve and current curve.
- C = Counter E. M. F. curve.
- D = Fundamental E. M. F. power curve.
- E = Counter E. M. F. power curve.

The total power developed is represented by vertical distances between the curves D and E.

connected in the external circuit. The load was a non-inductive one, and the speed of the dynamo averaged 1,450 r. p. m., which is equivalent to a frequency of a little over 24 periods per second.

The line R represents by its slope the resistance of the two coils, and curve B, which was obtained from the sum of the ordinates of the curves A and R, is the total effective E. M. F. characteristic of the coil. It will be noticed that the curve B shows an over-compounding effect up to a load of 7 amperes, and that the total effective E. M. F. was a maximum for a current of 4 amperes in the coils.

The term "armature reaction," as used above, is not intended to convey the idea that the current in the coils has any effect in varying or modifying the intensity of the flux passing through the field spools. The influence of

The compounding action of the armature currents in augmenting the effective voltage is a matter with which you are doubtless familiar. As a matter of interest, however, and in order to present a better picture of the wave forms involved, a series of curves has been plotted that includes the power curves and enables us to more readily appreciate the cycle of events that combine to produce this result. In Plate 18, curve A is the fundamental E. M. F. wave; curve B is the total effective E. M. F. wave and also represents the instantaneous values of the current; and curve C is the counter E. M. F. wave. Curve D is the power curve of the machine determined by taking the product of the corresponding instantaneous values of the current and the fundamental E. M. F. curve. Curve E is a power curve obtained by taking the product

of the corresponding values of the current and the counter E. M. F. The power curve of the total power developed by the machine, and which is proportional to the

equal to the vertical distances intercepted between the power curves D and E.

It will be noticed that the power area inclosed between

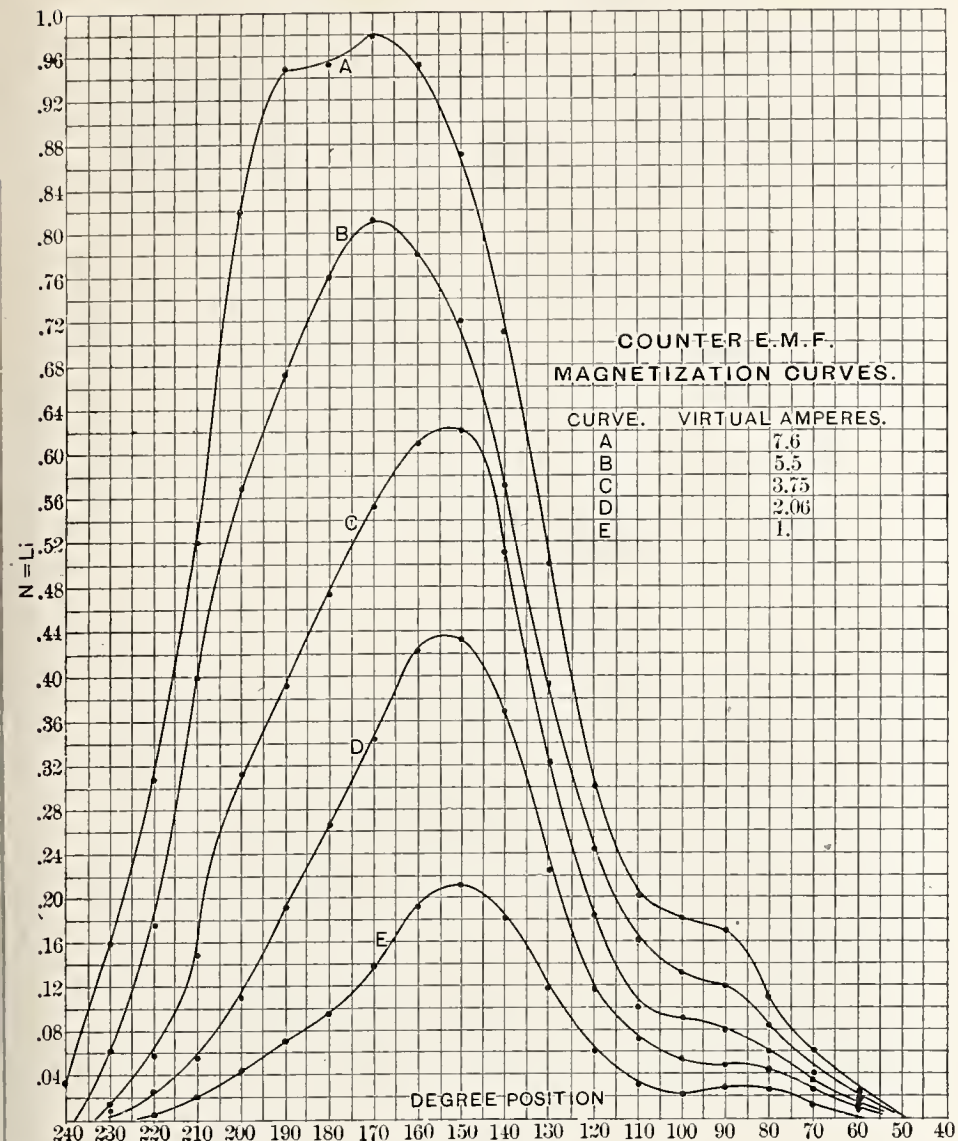


Plate 11.

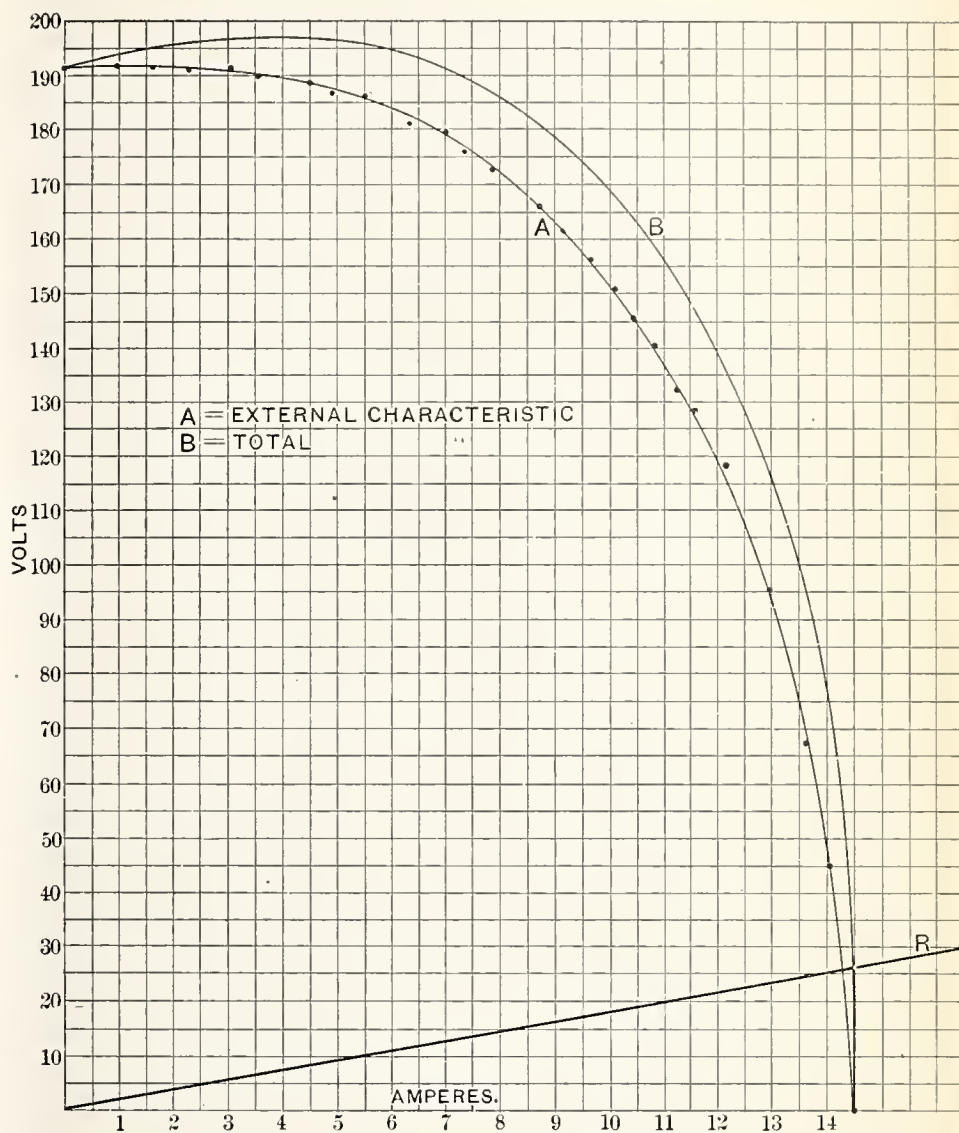


Plate 17.

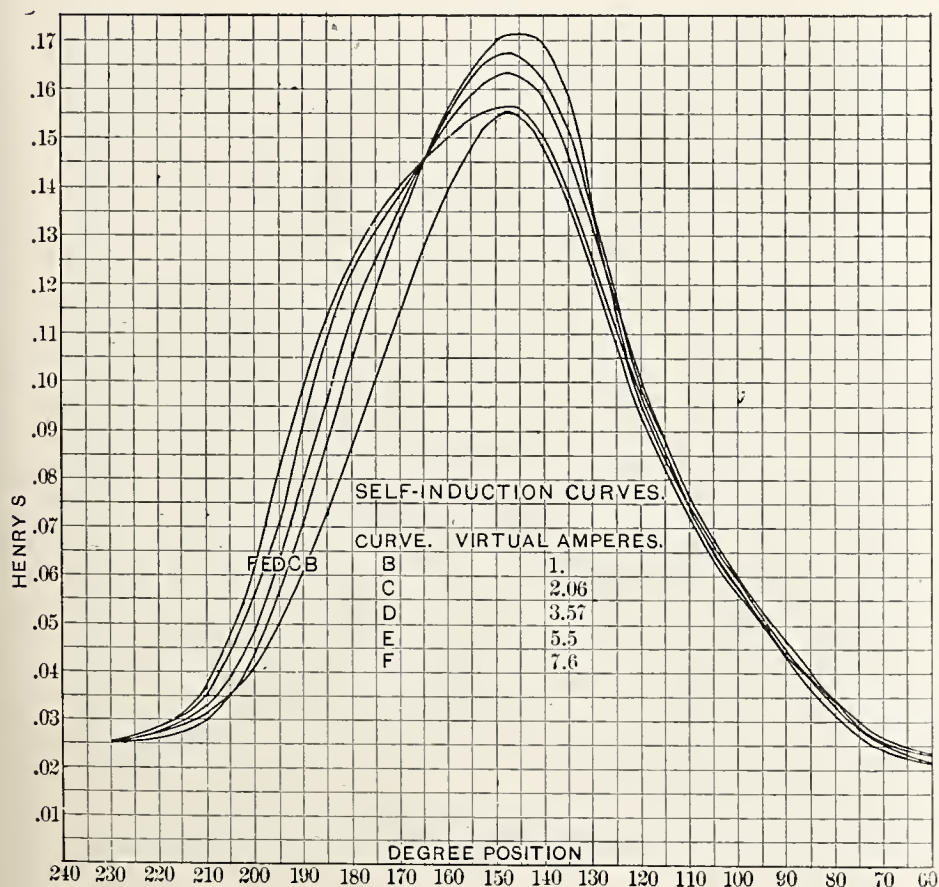


Plate 10.

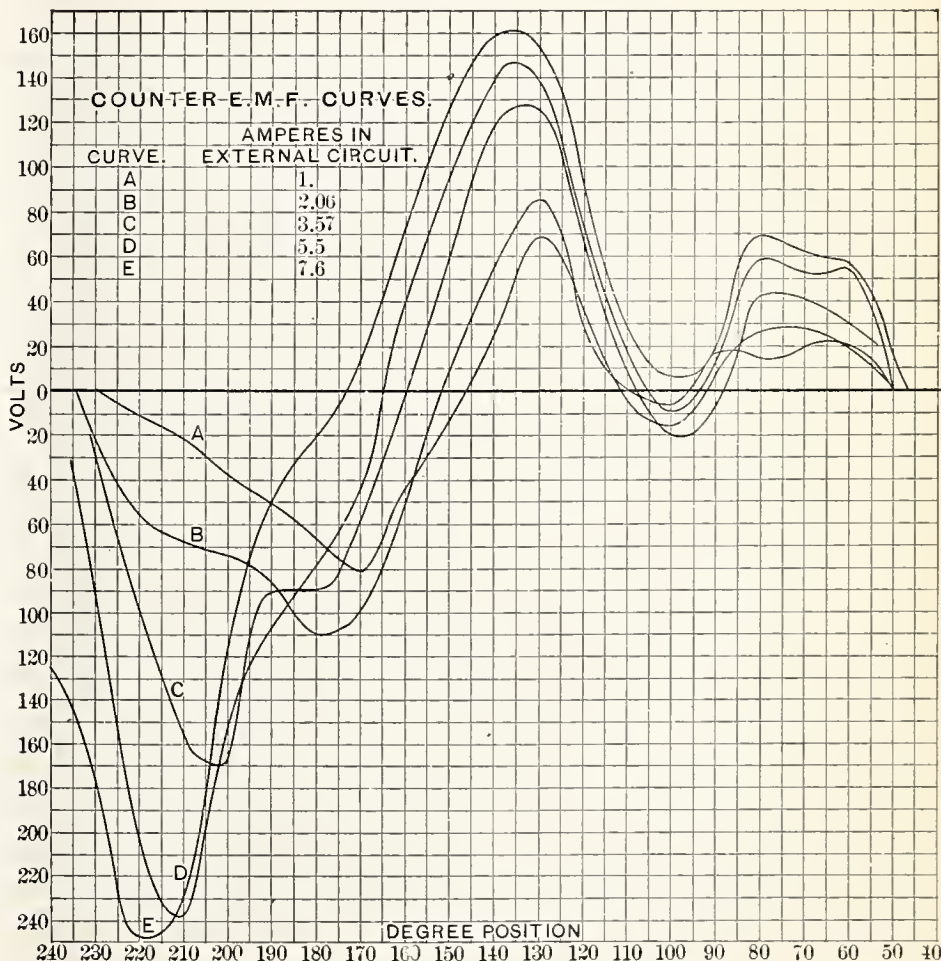


Plate 14.

product of the corresponding values of the current and effective E. M. F. curves, is not plotted, as its ordinates are proportional to the square of those of curve B, and

the curve E and the base line changes sign four times in a complete period, owing to the irregular form of the curve C, and that the sum of its positive and negative areas is not zero, but equal to a negative quantity.

Positive work done by the counter E. M. F. indicates

*J. A. Fleming, "The Form Factor of Alternate Current Curves." London "Electrician," vol. xxxvi., p. 338.

power absorbed from the circuit. The energy consumed in overcoming the hysteresis and eddy current losses in transformer cores is a familiar example of this fact. Negative work performed by the counter E. M. F. in the same way represents power given to the circuit. In the present instance the negative area is due to a peculiar combination of irregular wave forms, involving the inductance curve, the current curve, the curve of the magnetism inducing the counter E. M. F., and the curve

In other words, the current is a maximum when the inductance is least.

This results in the production of a wave of M. M. F. of self-induction that is in advance of the current, and that produces a wave of magnetism in the coils which reaches a maximum midway between the peaks of the inductance and current curves. These phase relationships can be followed out by comparing Plates 10, 9 and 11. The wave of inductance magnetism (curve A, Plate 11) in-

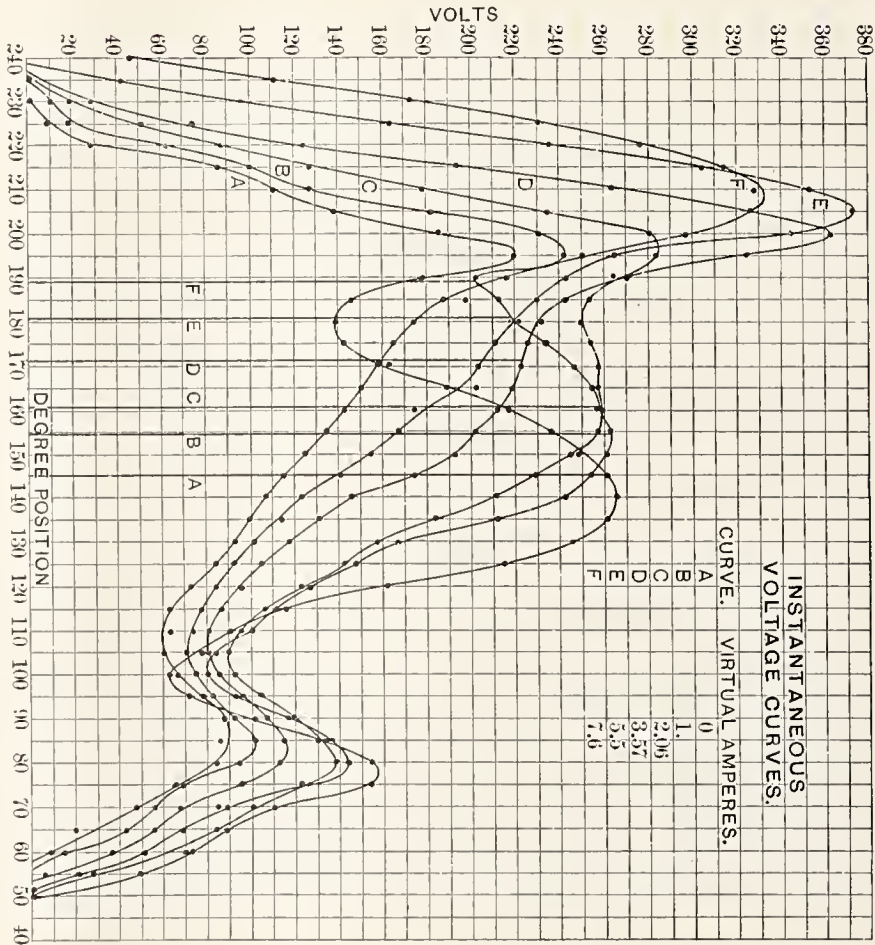
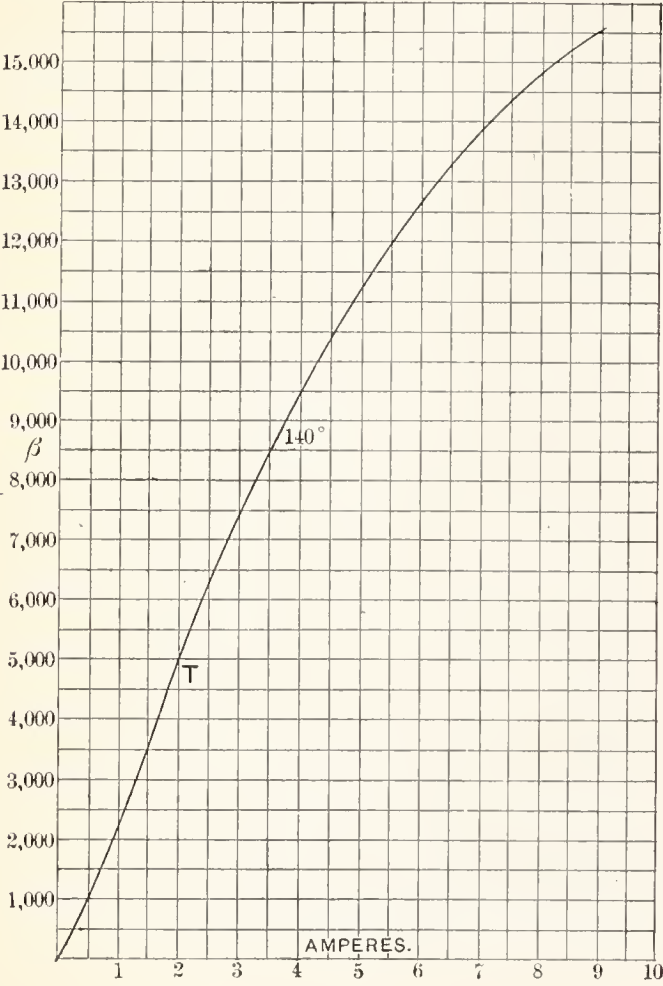


Plate 6.

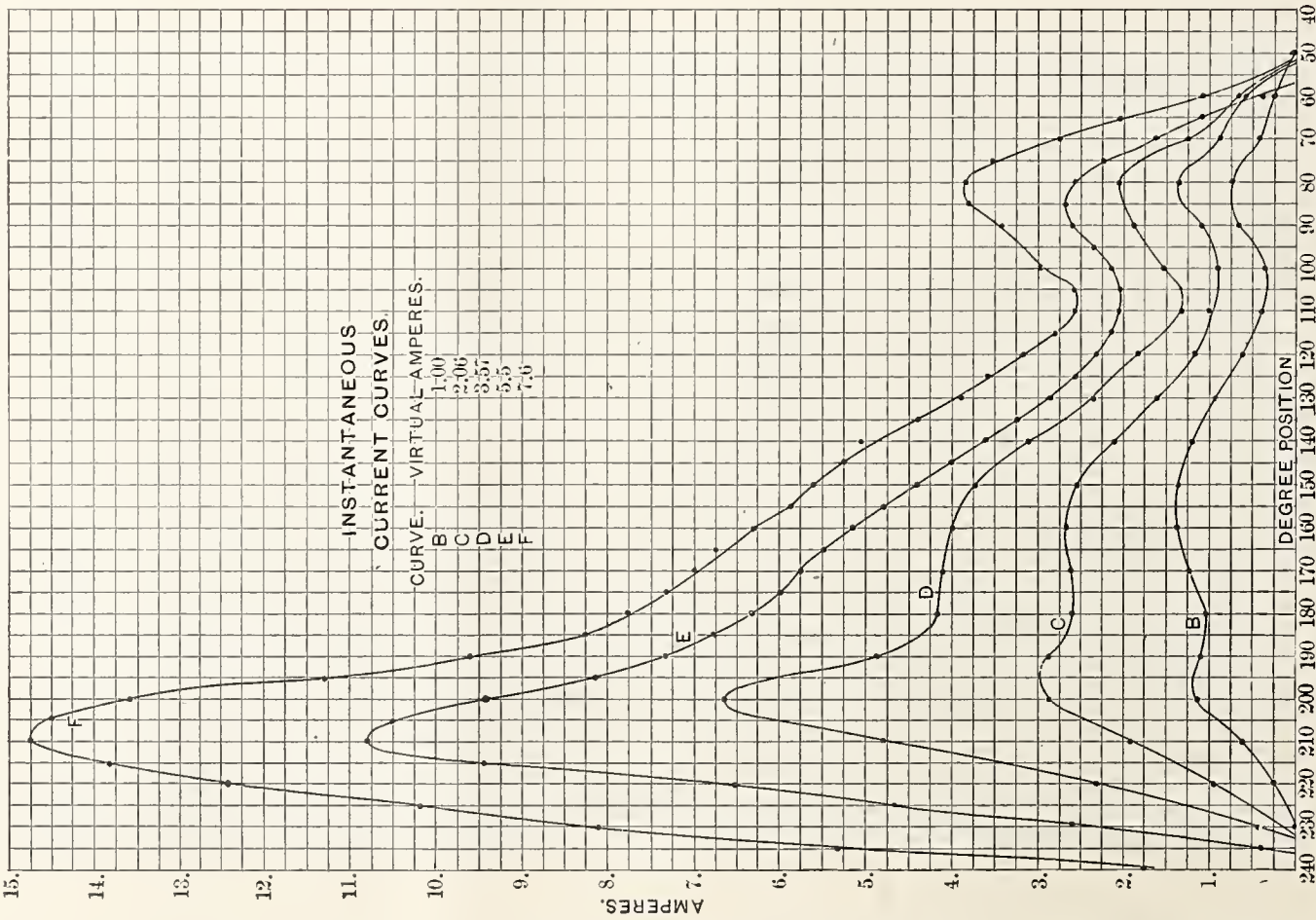
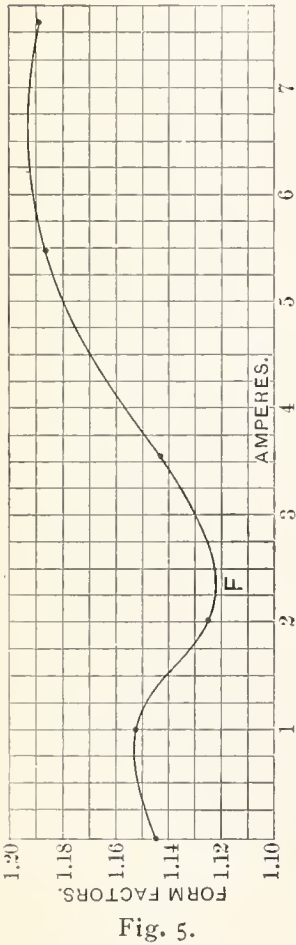


Plate 9.

of counter E. M. F. The peaks of all the curves are shifted more and more in the direction of rotation as the load comes on, but some are given a greater displacement than others. The peak of the current curve, for instance, lags behind the peak of the inductance curve.

duces a curve of inductance E. M. F., that has an effective phase displacement behind the current wave of less than 90°. This makes the effective phase displacement of the counter E. M. F. curve (curve C, Plate 12, and curve C, Plate 18) more than 90° in advance of the current curve,

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NEW YORK, JULY 2, 1898.

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THE ARC LAMP FOR HOME ILLUMINATION.

The illuminant most popular in New York city, mainly on account of its cheapness, is gas. That which holds second place, though far superior in convenience, is electricity. The use of electricity at home for illuminating purposes is being seriously considered by the great companies supplying light and power in different sections of the city. The incandescent lamp is universally recognized as the most satisfactory source of illumination that can be employed for domestic purposes, and its use in consequence of these qualities has become widespread. But the signal success of the incandescent lamp is being encroached upon by a lamp which possesses features of similarity and yet of absolute difference. The lamp to which we refer is the enclosed arc lamp, whose life is already one-quarter of that of the incandescent lamp, and its illuminating power and efficiency much greater. The enclosed arc lamp is a hybrid type. It would in many respects suit the ideas of those desiring a strong white light in the home, if the same is already equipped with an electric light plant of large or small dimensions. From an efficiency standpoint, the arc lamp is undeniably in advance of the incandescent lamp, but the difficulty of making arc lamps of low candle power which would require but little attention has been too great to allow of a comparison between the two in the home.

The final adoption of the enclosed arc lamp for street lighting and in many cases for interior illumination has made several manufacturers attempt the construction of small lamps which would meet the commercial requirements satisfactorily. These lamps, if only burning through an interval of seventy-five hours, would prove a valuable addition, in the respect that their cheapness of operation and unusual brilliancy would from an economic and hygienic standpoint be a means of making them an indispensable element of home comfort. The worthy inventor of a one or two hundred candle power arc lamp of

the latest design, burning for a period of fifty, seventy-five or one hundred and fifty hours without attention, will find a broad field for its introduction and, without doubt, profits accruing from the sale of them which will add greatly to his material interests.

The present enclosed arc lamp is used in conjunction with a thick and rather substantial pair of carbons. A smaller lamp provided with thinner, though not necessarily longer carbons, would burn at a lower pressure with less current and give a light of remarkable brightness. The past experiments of the inventors of the enclosed arc lamp have shown them clearly that in its present form power consumption has been sacrificed to life, and the candle power obtained for a given wattage is less than we find in the ordinary old-fashioned form of arc lamp. A small enclosed arc lamp which will automatically feed itself with carbon pencils as required, represents a future innovation which would exercise a remarkable influence upon the opinions of those still in doubt as to the advantages, economy and unequalled convenience obtained by the use of electricity for home illumination.

LIGHTNING DISCHARGES AND HIGH FURNACES.

The invention of the lightning-rod has doubtless saved many lives and much property from destruction. The efficacy of the lightning-rod has been for many years a subject of discussion on account of certain cases brought forward that antagonized a belief in their universal serviceability. Strange as it may seem, the German scientists have discovered, during a series of observations, that furnaces and buildings provided with high chimneys are not protected from lightning discharges even though equipped with lightning-rods. Chimneys that have the bad habit of smoking are very likely to be the seat of a static discharge because of the smoky particles providing a circuit to the ground. In all probability the theory, which is rarely explained, that it is dangerous to sit near a fireplace during a thunder-storm, may find its foundation in this phenomenon. A heavy smoke composed of carbon particles is in many respects a much better conductor of high potential oscillatory discharges than a solid metallic rod. One of our best known electrical engineers once suggested the use of lightning-rods composed of short segments separated from each other by air gaps. This idea is somewhat faithfully carried out in the use of a smoke column for a lightning-rod. Although from a scientific standpoint the reason why high chimneys are struck may be attributed to the fact that their elevation and consequent nearness to the charged body (the cloud), acting inductively upon them, brings about a condition of higher potential, it seems also likely that the escaping smoke adds greatly to the danger of a powerful electrical discharge being precipitated on the chimney itself. The summer season is well on by this time and the frequency and intensity of thunderstorms apt to increase. This will be thoroughly appreciated by the fortunate possessors of summer homes, isolated from other buildings of any size or consequence. The protection of these structures from injury is better guaranteed, however, by the use of lightning-rods than any other means man has as yet devised, and we would advise our friends at the seashore and country to make provision for such a probability.

The percentage of fatal cases resulting from lightning discharges is about one one-thousandth of a per cent. or about one in a million.

The safest buildings are, of course, those built with an iron framework; wooden structures are never exempt from the risk of injury by a lightning stroke. The serious and often fatal results of negligence in the erection of lightning-rods have called and will call attention to the necessity for using rods properly erected and of a reliable construction.

and therefore the product of the instantaneous values of the counter E. M. F. and current curves gives a power curve having an excess negative area. It is rather difficult to estimate the phase position of a wave that has an outline as irregular as that of the curve C of Plate 18, but it is best approximated by noting the location of its greatest positive area, and this, in the case in hand, is early in each half period.

Conclusions.

An inspection of curves B and D of Plate 18 shows that any decrease in the maximum slant of the curves of Plate 11 will decrease the amplitude of the 200° peaks of the counter E. M. F. curves, and thereby decrease their form factors, and at the same time decrease the form factors of the effective E. M. F. curves. This is what occurs in the case of curve D of Plate 11, owing to the great amplitude of the inductance loop for a value of the current of two amperes, which also accounts for the drop in the "form factor curve" of Fig. 6. This curve represents the form factors of the E. M. F. curves of Plate 6, and of the current curves of Plate 9, plotted relatively to the virtual value of the current flowing in the coils at the time the curves were taken. The form factors have been calculated according to Fleming's* definition, which is that the form factor equals the ratio of the square root of the mean square of the ordinates of the wave to the true mean ordinate of the wave.

The influence of the inductance of the coils upon the form factor can best be appreciated by looking at the curves of Plate 10. They all have the same width of base, but vary in amplitude, and necessarily other things being equal, produce counter E. M. F. curves having the smallest form factors when currents which are favorable to a large armature inductance are flowing in the coils.

It is noticeable that the right sides of the curves of Plate 10 all have the same slant. They therefore produce counter E. M. F. loops having similar shapes (see Plate 14). On the other hand, the left sides of these curves vary in shape, owing to variations in reluctance at this part of the cycle. Greater variations, therefore, occur in the instantaneous values of the counter E. M. F. induced in this part of the cycle than in the former part, with the result of increasing the form factor where the induction curves corresponding to the current curves are relatively low and broad, and of decreasing the form factor of the counter E. M. F. curves where the inductance curves are narrow and high.

Again, since the maximum peak of the effective E. M. F. curve is opposite in sign and position to the leading peak of the corresponding counter E. M. F. curve, and since the sum of these peaks must not be greater than the adjacent peak of the fundamental E. M. F. wave, we see that an increase in the form factor of a counter E. M. F. curve causes an increase in the form factor of the corresponding effective E. M. F. curve, and vice versa. That the changes in the form factor of the effective E. M. F. curves are approximately directly proportional to the mean width of the inductance loops, and inversely proportional to the amplitude of the inductance loops. These conclusions are amply sustained by the data presented.

The variations that take place in the value of the armature inductance when the load is increased, lead us to expect that there is a proportionally greater increase in the value of the counter E. M. F. as the current passes 2 amperes in value. An accelerated increase in the counter E. M. F. would have the effect of making the compounding proportionally greater, for it would add a proportionately greater amount of energy to the circuit, owing to the fact that although the amplitude of the counter E. M. F. is increased, its phase position remains practically the same. That a positive acceleration does occur in the rate of increase of the counter E. M. F. is true, and also, that this is followed by a negative acceleration. The value of

the counter E. M. F. depends upon the intensity of the current, and increases as the current increases. It, however, does not increase at a rate that is proportional to the rate of increase of the average intensity of the current, for its value also depends upon the armature inductance which first increases to a maximum and then decreases, as is shown by the curves of Plate 10. We, therefore, find that as the average intensity of the armature current is uniformly increased, the counter E. M. F. experiences a proportionally greater rate of increase up to a certain point, and that after this point is passed its rate of increase is diminished.

This means that as the load comes on, the value of the effective electromotive force increases above the value of the fundamental wave for a time. For from the relative positions of the highest peaks of the curves B and C of Plate 11, it will be evident that any increase in the virtual value of the counter E. M. F. will cause the virtual value of the effective E. M. F. to increase also, and any increase in the virtual value of the effective E. M. F. above the virtual value of the fundamental wave of E. M. F. raises the potential at the brushes. The fact that the virtual value of the effective E. M. F. finally falls below that of the open circuit E. M. F. is due to the ultimate gradual decline in the armature inductance wave and a consequent change in the form of the counter E. M. F. magnetization curve, which reduce the amplitude of the leading peaks and augment the amplitudes of the trailing peaks of the counter E. M. F. curves. This effect is apparent in curves D and E of Plate 14.

As exemplified in the curves of Plate 7, we find that the maximum induction threading the armature coils occurs when the form factor is least, and the armature inductance greatest. Again, the analysis of the forces involved shows us that the point F on the form factor curve of Fig. 6 and the point T on the "B & H curve" of Fig. 5 are intimately connected.

The double role played by the permeability of the iron of the armature core and pole-pieces, and the importance that may be attached to the permeability of the iron under favorable conditions is forcibly brought to our minds. We are enabled to see a little more clearly the complex relations of the interlinked forces that act and react upon one another in the conflict of the air-gaps, and there is established a basis for the analysis of a problem that has been more or less obscure.

*Purdue University, Lafayette, Ind.,
June, 1897.*

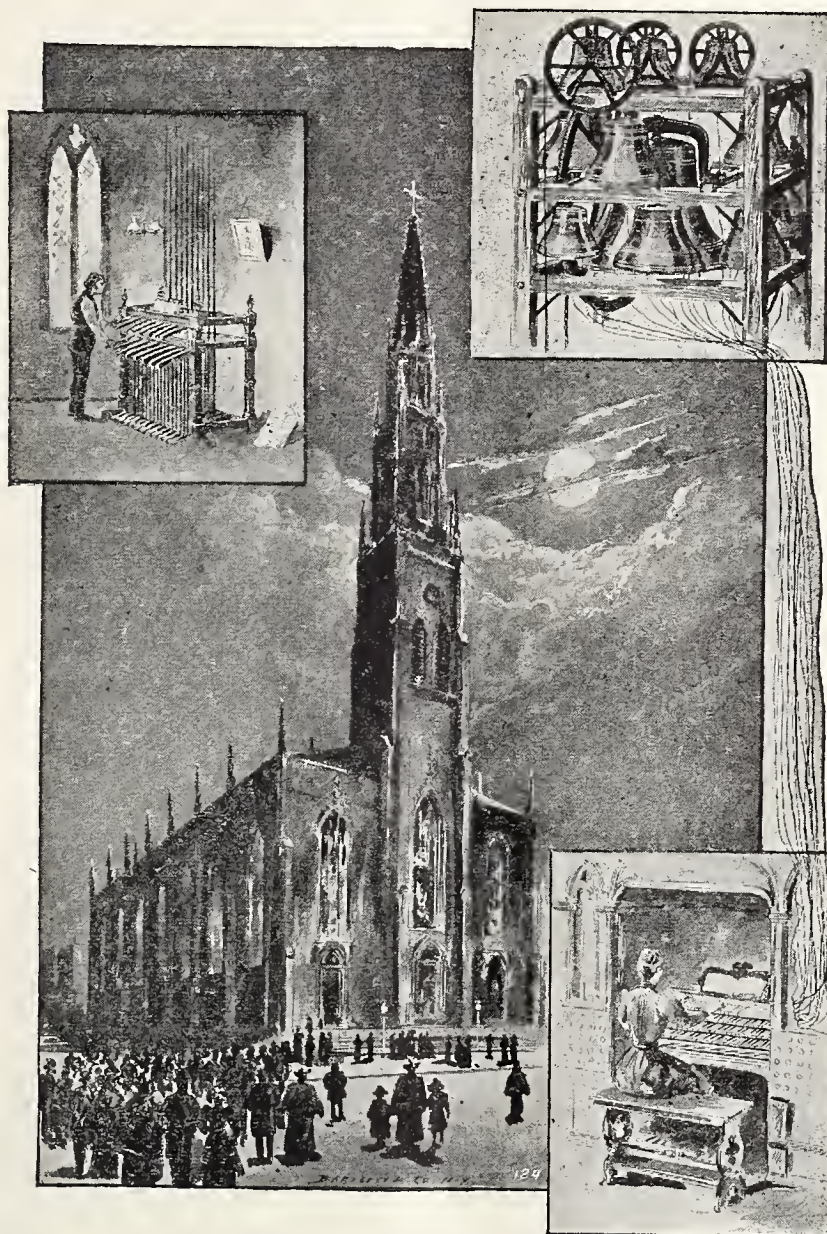
COLT'S MACHINE GUNS. — The principle of the Colt guns, the very latest weapons of modern warfare, gives no hint of their murderousness. A three-foot blued heavy barrel with a pistol butt and trigger and a calibre, the size of a pea, this barrel fitting into brass pivots that permit a sweeping aim, up, down or around—that's all. Yet through that little aperture, smaller than a baby's finger, are projected invisible death engines that would cut platoons of men in pieces. The gun is literally a death buzz saw when swept slowly from right to left and left to right. If held stationary for a moment the discharge assumes the force of a shrapnell shell that never stops, and ordinary torpedo boats may be sunk by its force. By the side of the barrel is a wooden box. In this 1,000 Lee rifle cartridges, with the small calibre steel bullets, charged with smokeless powder, are coiled on a tape, like an endless cartridge belt. The end of the tape is pulled sidewise through the gun, the trigger is pulled, and then the gun shoots, ejects the loads without further human agency. After that the gunner simply directs the sweep of fire. A few inches from the muzzle is a vent down into a chamber underneath in the barrel. At the first discharge a small percentage of the gas proceeds through this vent, forces out a lever as the marksman's hand forces down the lever of a Winchester rifle, and this flying lever in turn propels the mechanism, and as the

spent cartridge is ejected, another is drawn in and struck by the hammer. In an instant the gun pours bullets like a stream from a hose, each cartridge exploding the next, at the speed of 200 a minute. Directed at a file of men up to 700 yards the effect is terrific, for the bullets of steel, that look like tiny pencils, will go through six men. Some time ago Lieutenant Pond tried the gun at the New York navy yard. He had twenty inches of oak and a three-eighths inch steel plate. To make sure, he added another one-eighth inch plate. Then he couldn't find the bullets. Upon search he found that they had gone through the twenty inches of oak, the three-eighths-inch steel plate, the one-eighth inch steel plate, two sides of an old iron boiler and the brick walls of the building.—Boston Journal of Commerce.

gen being 16. It is believed that the new gas is monatomic and constitutes an element. These facts go to prove that the atmosphere contains a hitherto unknown gas heavier than argon and with a characteristic spectrum less volatile than nitrogen and oxygen and argon.

Prof. Ramsay was unable to absolutely determine its position in the periodic system. He, however, hazards the conjecture that the pure gas has a density of 40 and an atomic weight of 80, and that it may be classed with helium. The investigations are being continued, and a larger quantity of the gas is being prepared.—“Engineering and Mining Journal.”

Mitchell, S. D.—The electric light plant destroyed by fire at a loss of \$5,000; no insurance.



Electric Chimes, St. Alphonsus Church, Baltimore, Md. Equipped 1893.—Crocker-Wheeler Electric Company.

A NEW ELEMENT IN AIR.—According to a London letter, Prof. Ramsay, the joint discoverer with Lord Rayleigh of argon, has, with the assistance of Mr. Morris Travers, eliminated from the atmosphere a new gas, which he calls crypton. According to a communication made to the Academie des Sciences in Paris, through M. Berthelot, the discoverers received from Dr. Hampson 750 cubic centimeters of liquid air, which they reduced by evaporation and collected in a tube. A gas was furnished by the residue. This gas was deprived of its oxygen by the help of metallic copper, and of its nitrogen by the action of the electric spark, and of its oxygen after that by a mixture of magnesium and pure lime. This effected, there remained 26 cubic centimeters of gas, which presented, besides a weakly defined spectrum of argon, an additional spectrum till then unknown. It was characterized by exceedingly brilliant lines, one almost identical with D₃. The other green may be compared in intensity with the green line of helium. Its wave length was 5,566.3. Another slightly weaker gave 5,557.3. The density of the gas was approximately 22.5, that of oxy-

NOVEL APPLICATIONS OF ELECTRIC LIGHT AND POWER MACHINERY.

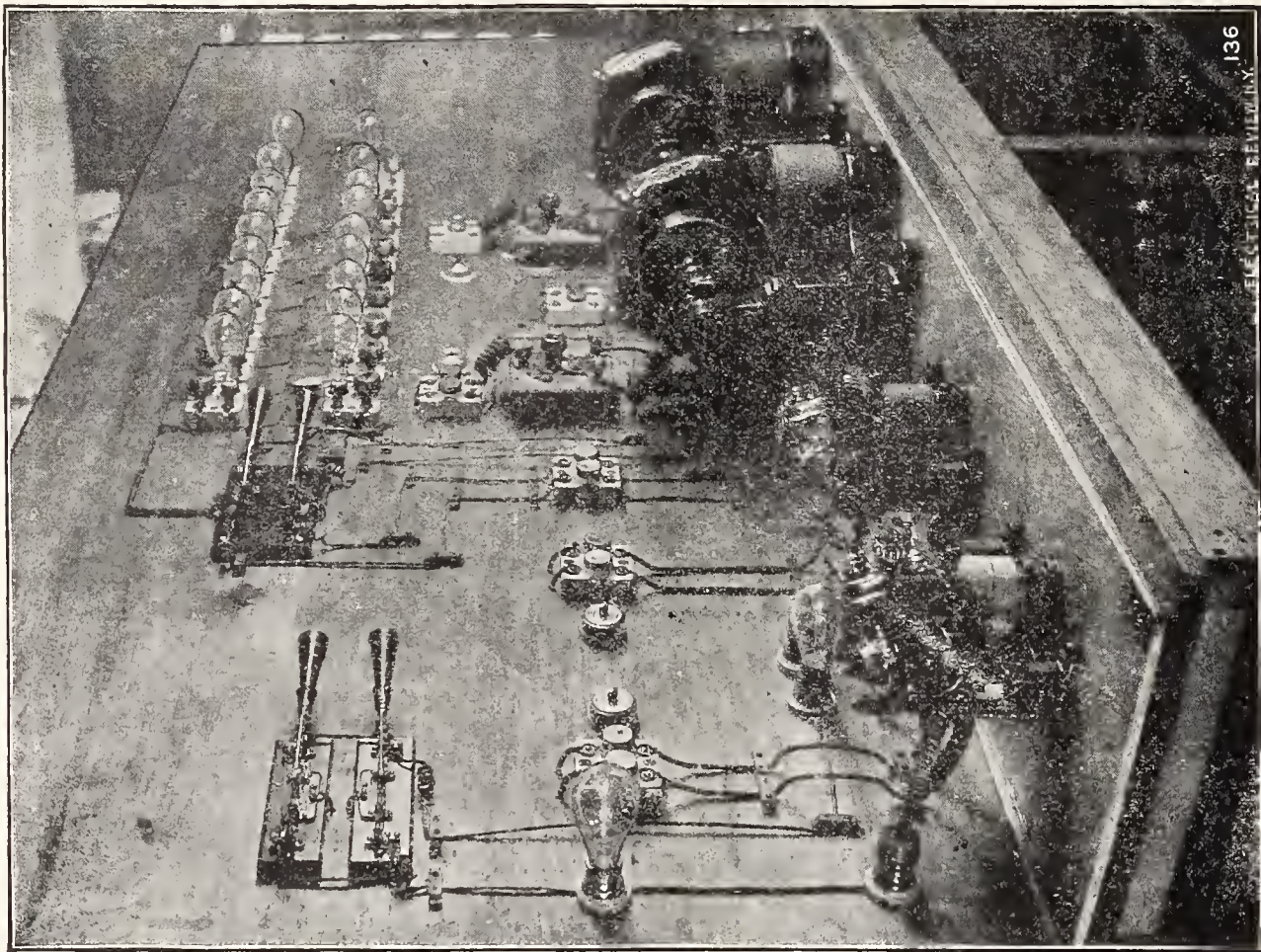
A visitor to Baltimore, Md., will find the church of St. Alphonsus equipped with electrical apparatus for the operation of its machines. The silvery tones that echo through the air on Sunday morning are produced by means of an electric keyboard which operates the bells with absolute certainty, and such nicety that the blow given is either pianissimo or forte. The electric chimes pealing through the city awaken in but few minds a sense of the uniqueness of the cause by which these tones are produced. Not alone is electricity used for ringing the bells, but in addition it is made use of for pumping wind into the organ.

Some day in the future, places of worship will be connected to the home by wire, enabling those incapacitated from attending service to hear it in the privacy of their own chamber and possibly (though the chance at present seems remote), of actually seeing in a lifelike manner the

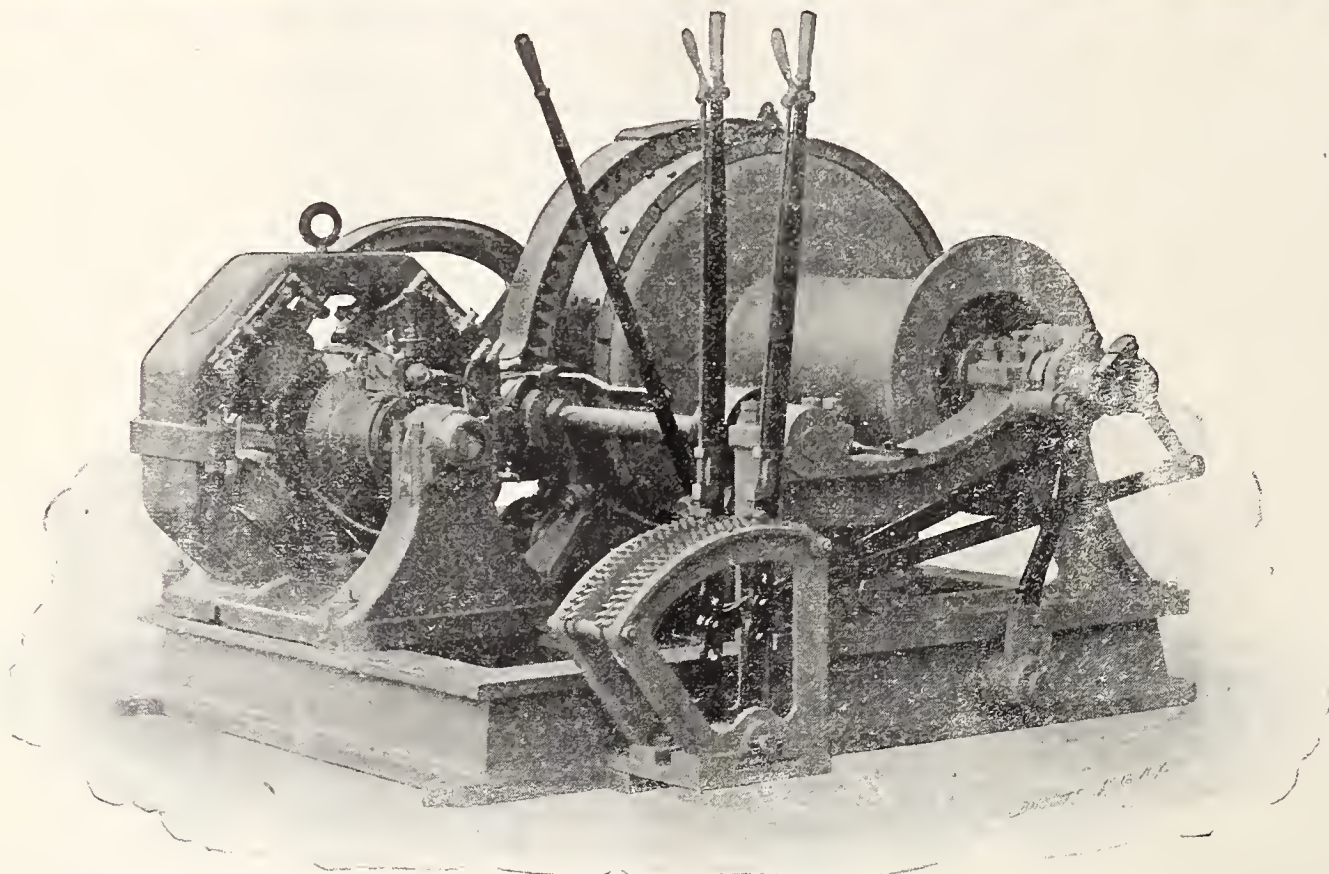
pastor, the audience, and, in fact, the whole church interior.

Edward Bellamy, in his famous novel entitled "Look-

familiar feature in large apartment houses and those of hybrid type, half hotel and half flat. Its use for elevator service, and, in fact, for all sorts of hoisting purposes, has



Battery of Dynamotors for Telephone Centrals.



Size 15 Motor and Crook Dock Hoist.—Crocker-Wheeler Electric Co.

ing Backward," touches upon such a scheme and dates it only one hundred years hence, so the time cannot be very far off in the light of our present progress. In the large central offices of telephone companies, a peculiar application of the motor transformer is made for the purpose of raising and lowering the pressure to suit the requirements of the outside line. Not only do we find small machines in use here, but also for telegraphic service.

The Western Union are at present operating their quadruplex system by means of small dynamos in place of batteries. The motor is being introduced very rapidly into the home, so that it has become by this time a

become quite general. The advantages of a motor for either of these purposes makes it far superior to the hydraulic or steam system.

One of the most interesting applications of electrical machines is found in the use of small direct-connected electric-light plants. A Case engine in connection with a Crocker-Wheeler motor, mounted on a small bed plate and occupying but a corner of the room or basement in which the switchboard is situated, has proven a cheap and simple means of producing electricity for light, heat and power in a small way. Many private homes, the owners of which look with disfavor upon any bulky apparatus

they may have occasion to use, admit that a small electric-light plant of this description proves itself so great a convenience that under no consideration would they part with it.

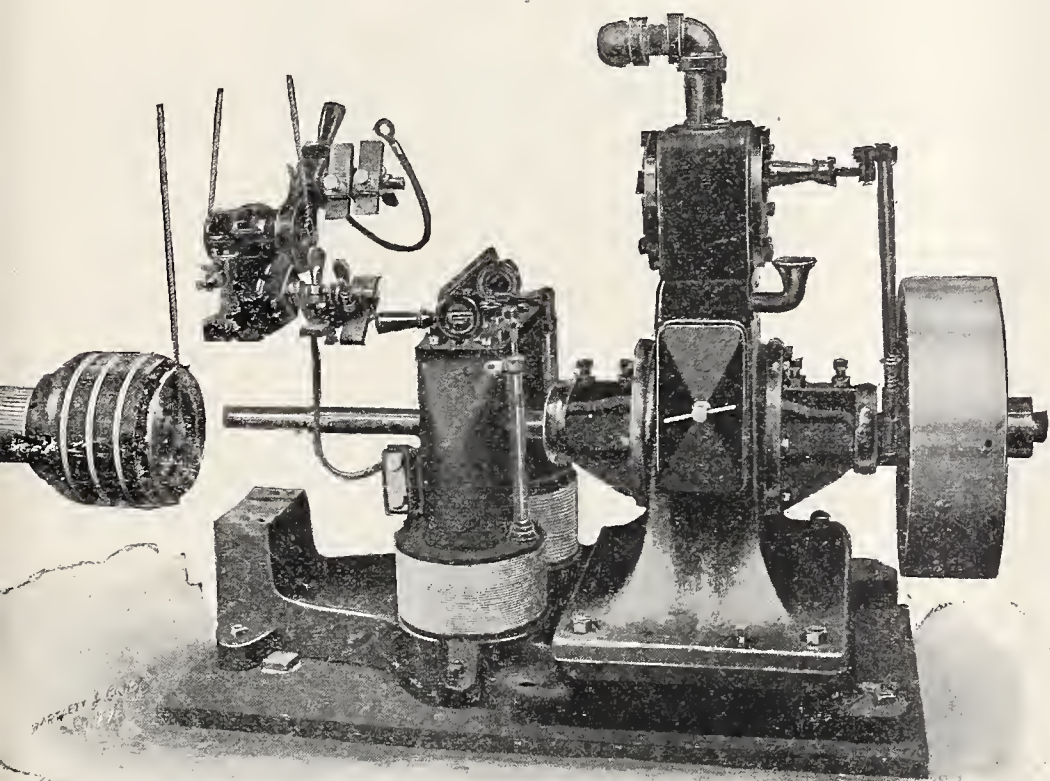
The trade carried on at present by manufacturers of electrical machinery is not one-tenth of what it will be when the great masses are fully awake to the wonderful advantages its use implies. Every home should have electric light, fans, heating and cooking apparatus, and it will not take many years for such so-called innovations as these to become an article of ordinary domestic use, familiar to all those in possession of their own homes.

NET MADE OF SPIDER WEB.—An especially fine net, made entirely of spider's web, is being manufactured, says Textile America, in the professional school at Antananarivo, Madagascar. The process is a very simple one. Thread of several dozen spiders is wound on winders, the quantity produced by each spider ranging from fifteen to forty yards. The covering of the web is removed by re-

per square foot of electrode; Wm. Crookes has already treated auriferous ores by the alternating current; their example has now been followed in quite a new direction, and there is no temerity in predicting, as an evolution in the application of electrical energy to the separation of metals and to the winning of gold, the use of high tension currents for electro-deposition.—E. Andreoli, in the "Engineering and Mining Journal."

A NOVEL, UNIVERSAL ELECTRO-PLATING OUTFIT.

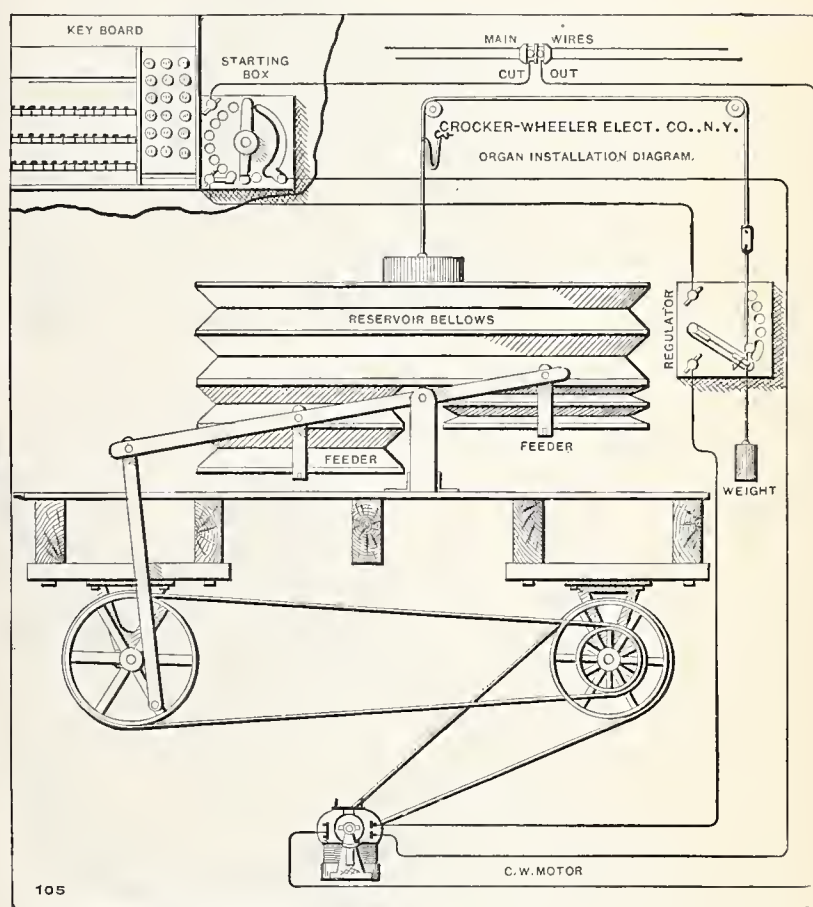
The art of electro-plating has always possessed more or less fascination for the amateur and dabbler in electricity, but on account of the uncertain results obtained through not properly compounding the solutions used, and the expense of materials required in the various stages it has been reluctantly dropped as being not quite within reach. The "Model Electro-Plating Outfits," manufactured by the U. S. Electro-Chemical Company, of 127 Crosby



Size 3 Dynamo and No. 3 Case Engine, Disassembled.

peated washing, and the web made into a thread of eight strands. When the thread is spun, it is easily woven into a gauze, which is very fine, but very strong.

It may seem paradoxical to say that the electrolytic methods of the future will differ altogether from those which are at present applied to electro-deposition. But there is no reason to believe that the continuous current is the only one fit for electro-chemical purposes. Not very long ago the alternate current and high tension were looked upon with diffidence, even by electricians of universally recognized ability. They reign to-day, nevertheless, and electric lighting, transmission of power, etc., could not in many cases be effected without making use of them. Why should we not assume that we may leave on one side the old electrolytic system, and adopt a new one based on the action of alternating currents and of high tension, in order to obtain in much less time and at a considerably cheaper rate some results with which the continuous current, at present actually used for electrolysis, could not compete? Swan has overruled the laws of electroplating by the use of weak currents, and deposited copper at the rate of 1,000 amperes



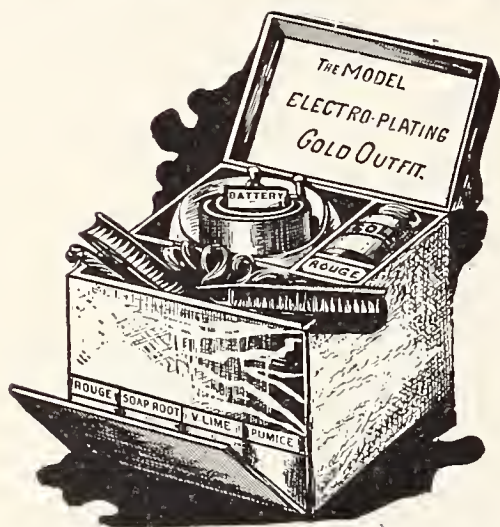
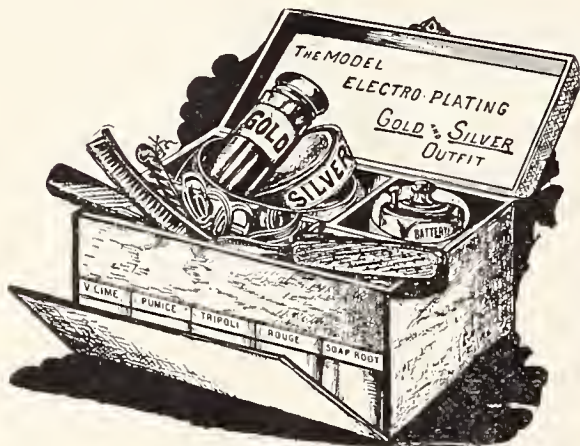
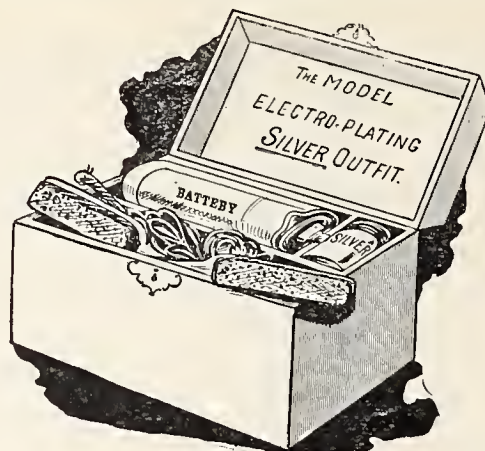
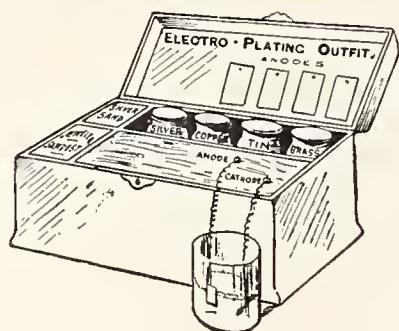
Organ Outfit, Connection Diagram.

street, New York city, will therefore be hailed with a good deal of satisfaction by the hitherto unsuccessful electro-plater.

As mentioned above, the chief difficulties in the path of successful plating were caused by not properly compounding the various plating solutions or baths. As the success and quality of the deposit depends entirely upon the solution, it will be seen that the same needs a great deal of care, skill and attention. These difficulties are, however, overcome by the use of the "U. S. E. C. Co. Electro-Plating Salts," which require only the addition of water to be ready for immediate use; no cyanides, chlorides, nitrates, etc., being necessary. The salts are manufactured in gold, silver, copper, brass, oxide, tin, etc., and are dry preparations, thus enabling the plater to mix up any desired quantity. The amateur is thus relieved of all apprehension regarding the quality of his plating bath. These "Model Electro-Plating Outfits" contain everything required for plating, such as tanks, brushes, rouge, saw-dust, lime, wire, etc., besides a full and complete book of instructions, which explains every step in the various operations, and enables the amateur to do just as good plating as the expert.

The outfits are manufactured in various styles and sizes, as will be seen in illustrations, the prices ranging

Mansfield, Mass.—F. L. Cady can give information concerning construction of electric-light plant.



Model Electro-Plating Outfits.

accordingly, and are meeting with great success, not only among amateurs, but professional platers as well, to whom the simplicity and ease of operation with these outfits appeal strongly. The company have received a number of testimonials from large firms throughout the country using their salts, and they all agree as to excellence and quality of the same. Circulars describing the various outfits can be obtained by writing the company at the above address, and we would advise those of our readers interested in plating to write for further information.

Mena, Ark.—The Mena Telephone Co. has been incorporated by H. M. Quigley, Edward Kerogh and J. S. Kelley. Capital stock, \$5,000.

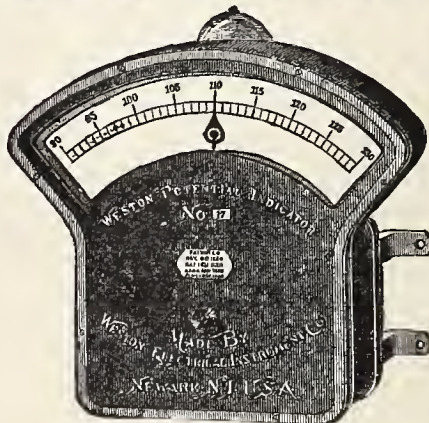
Lawrenceburg, Ky.—George W. Dyer, of Princeton, Ky., has been awarded contract to supply the city with electric lighting.

Lancaster, Pa.—The Lancaster Electric Light, Heat and Power Co. held a meeting of stockholders recently, and decided to increase capital stock from \$150,000 to \$250,000, and also to issue bonds to the amount of \$100,000 for the purpose of enlarging plant.

Elmer, N. J.—City Clerk may be addressed concerning the erection of electric light plant.

New Berne, N. C.—The Henderson Telephone Co. has purchased the New Berne Telephone system, and will expend several thousand dollars in improving same, putting in new switchboards, cables, etc.

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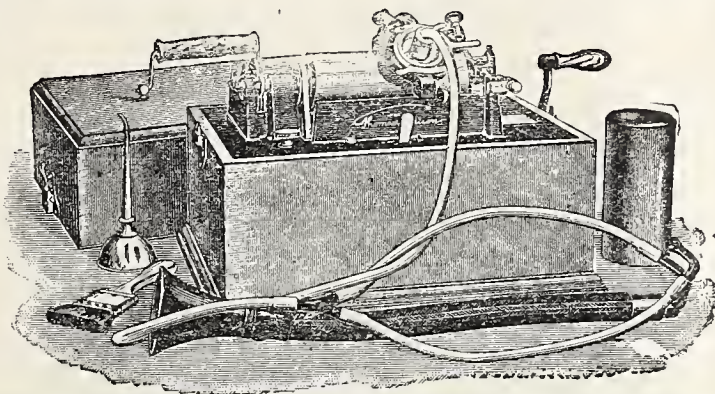
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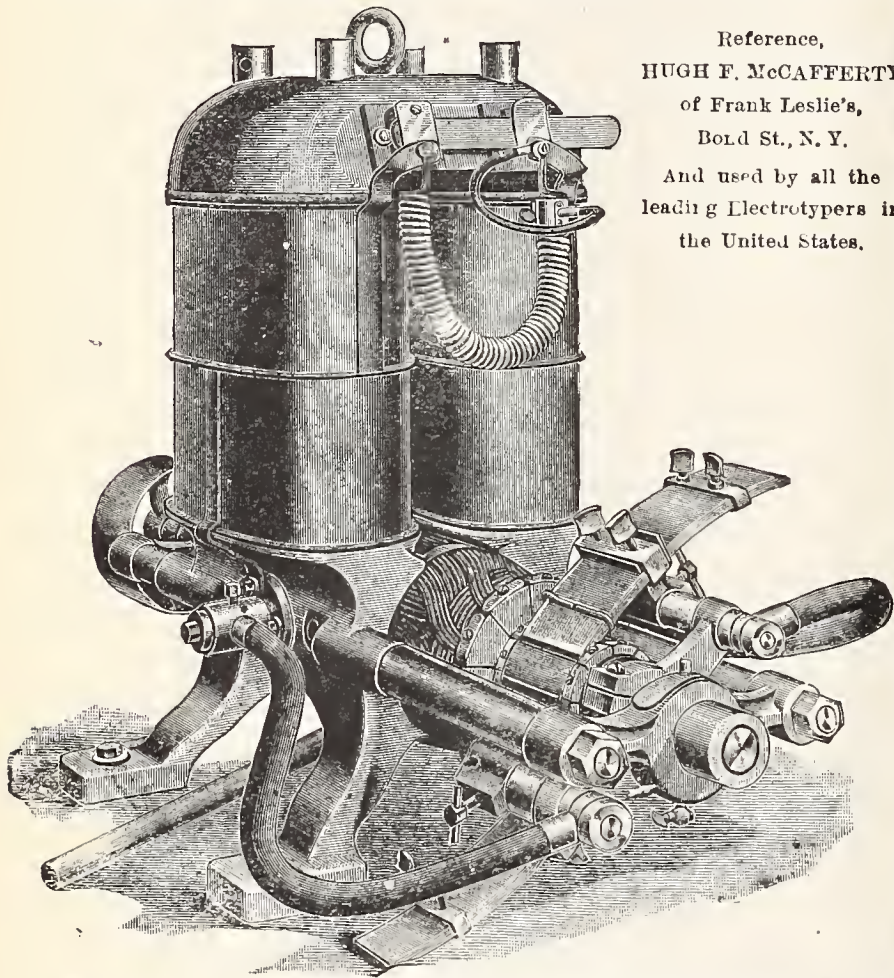
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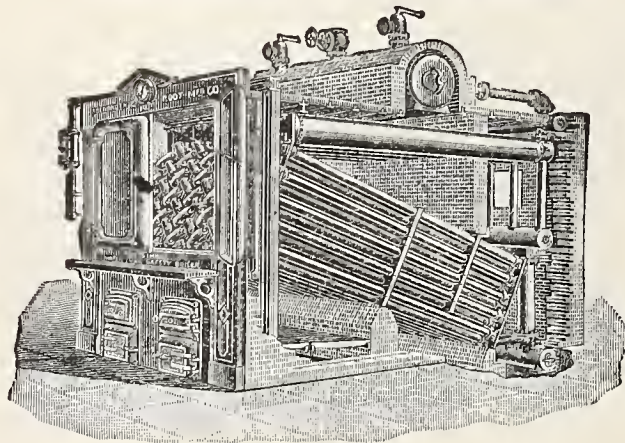
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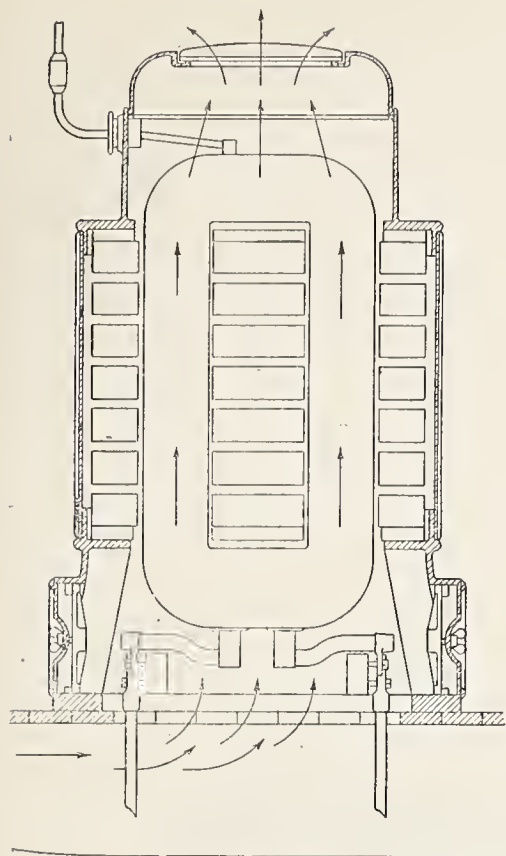
ABENDROTH & ROOT MFG. CO., 28 CLIFF ST.,
NEW YORK CITY.

The Electrical Age.

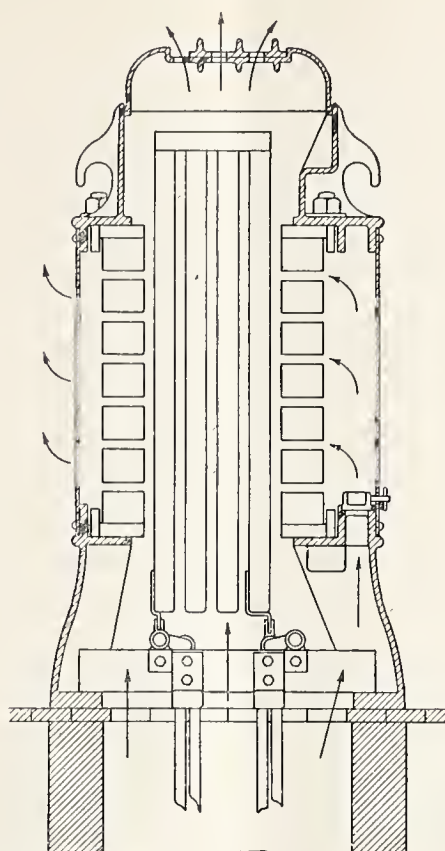
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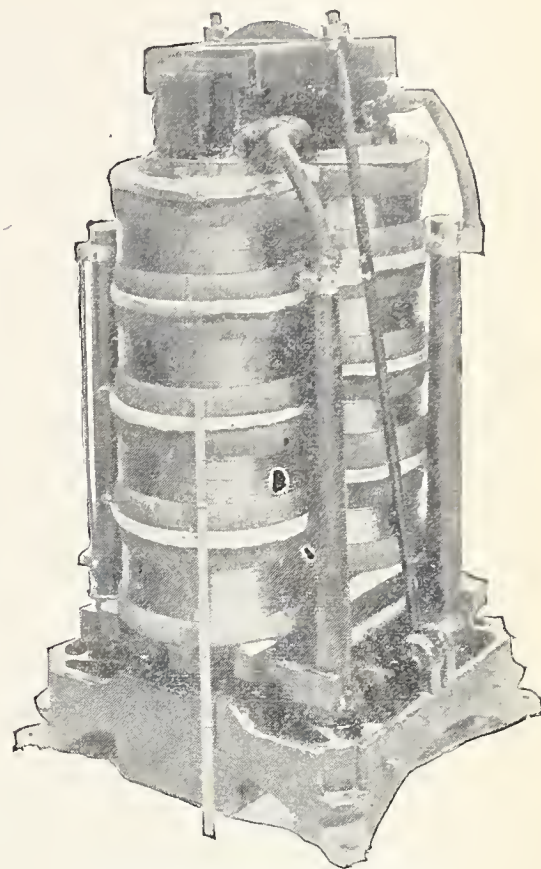
WHOLE NO. 582



Air Circulating in Air Blast Transformers.



Natural Draft Transformers.



COOLING LARGE TRANSFORMERS BY AIR BLAST AND NATURAL DRAFT.

To dissipate the heat generated in the cores and coils of transformers of large capacity offers considerably greater difficulty to the designing engineer than is the case with small transformers in which any design, consistent with reasonable efficiency, gives sufficient external surface to allow heat generated to radiate and so prevent undue rise in the temperature. With large transformers, however, the heat generated in the interior has less opportunity to radiate, and to dissipate it effectively without sacrifice of proportion or efficiency requires most careful design.

To construct large transformers, say, of 100-kw. capacity or larger, placing dependence for low temperature entirely on external radiating surface, necessitates too great a departure for economical proportions, and various designs have therefore been adopted in which provision is made for the circulation of a cooling medium through the interior of the transformer. If ducts passing entirely through the body of the winding are provided, they must be comparatively narrow, or the size and cost of the transformer will be excessive and the efficiency low; the space wasted is too great. With narrow ducts oil is not a reliable cooling medium. Its circulation under the best conditions is sluggish, while the ducts tend to close gradually under two causes—the swelling of the insulating wrapper on the coils and the collection in the ducts of a deposit derived from the slow solution of the various liquid insulations employed when winding the coils. To overcome these drawbacks a new design was introduced in which the height of the laminated core is small compared with the external dimensions of the punchings. A large proportion of the copper is external to the core, and the exposed ends are so spread apart as to give wide openings between the coils for the access of the oil. This design insures a low temperature in the exposed part, and even a moderate average temperature (measured by increase in resistance), but the central portion often becomes dangerously hot without giving any direct evidence of the fact; and it is no less serious to have a high tem-

perature in any part of the transformer than to have the entire winding at an unsafe temperature.

In large transformers the use of oil is undesirable for reasons other than its poor efficiency as a cooling medium. The General Electric Company introduced and adopted the system of air cooling for its large transformers. In air-cooled transformers currents of air pass constantly through numerous narrow ducts, and come into direct contact with the heated surfaces absorbing their heat. Low temperatures are secured without sacrifice of efficiency or increase of cost, and the insulation, being constantly in contact with the current of air, needs no additional protection to guard against deterioration.

Two methods are employed as standard practice by the General Electric Company in the construction of its large transformers. In the air blast type the current of cool air is forced upward through the core and windings. In the natural draft type the coils and iron are so proportioned and placed that large surfaces are exposed, and the temperature kept within safe limits by the natural circulation of the air.

The air blast type is designed for continuous operation, large output and high potential. In this type, the windings are subdivided into numerous independent coils, each separately and heavily insulated. With such subdivision the voltage generated in a single section is low even in transformers wound for a voltage of 15,000 to 20,000 volts, and the numerous air ducts between all the coils which this sub-division allows, in addition to the spaces in the iron lamination of the core, limits the rise in temperature to a few degrees only above that of the active cooling air current. The coils are wound with flat copper conductors, cemented together by an insulating compound before the exterior insulation is applied. The method of winding and insulating produces a strong coil, which will successfully resist any tendency of the conductors to vibrate. The primary and secondary coils are assembled in small intermixed groups with air spaces

between coils, and between every adjacent primary and secondary section are solid insulating diaphragms, which completely encase the primary winding except at either end of the core, necessarily left open to allow the air to circulate freely. At the end, however, the diaphragms project far beyond the coils, so that a surface insulation of great extent is provided between the primary and secondary. An additional insulation casing is placed around the entire structure of assembled primary and secondary coils, and separates the whole winding from the iron punchings assembled within and around them.

The cooling current of air is obtained from a motor-driven blower, and is forced from below through separate paths at right angles to each other, vertically through the windings and horizontally through the core. The admission of air is controlled by shutters at the top and at the side of the transformer. The power for the blower seldom exceeds one-quarter of 1 per cent of the total capacity of the transformer, and in most cases is much less, frequently not more than one-tenth of 1 per cent. It is considerably less than that which would be required to pump oil through an oil-cooled transformer of the same capacity.

Air blast transformers are used on 15,000 volts potential or under, and are constructed for higher potential when necessary. The efficiency under full load and partial load, determined under commercial operation conditions, is said to be extremely high. The regulation on both inductive and non-inductive loads, similarly determined, is remarkably close—an important essential when incandescent lamps and motors are operated from the same transformer. Over 100,000 horse-power in these air blast transformers has been installed, and no record yet exists of a burn out due to heating or overload.

In the natural draft transformers the dissipation of the heat is obtained by a natural circulation of the air around the coils. The core is formed of two upright legs on which the coils are wound. These are joined together by two yokes, which complete the magnetic circuit. The transformer proper is surrounded by a corrugated iron case, and rests on a substantial base of cast iron. The cool air enters from below and in passing through the transformer absorbs the heat and ascends, finding easy egress through the hood at the top.

Natural draft transformers are built in sizes ranging from 5 to 200 kilowatts. They require no attention, no blower outfit and may be located in any convenient place. The standard pressure for which these transformers are wound is 10,000 volts primary and 3120 volts or under, secondary. Transformers of higher primary voltage are built to fulfil special requirements.

WIRELESS TELEGRAPHY IN WALES.

The inventions of Herz and Marconi, respectively, have commanded much attention within recent years, and there has been a general feeling prevailing in this country that the experiments being conducted under the auspices of the Postal Department would result in the early establishment of telegraphic communication between distant points unconnected by wire.

It was reported in the press last year that Signor Marconi was personally experimenting within the limits of the port of Cardiff; that he had succeeded in demonstrating the practicability of his invention; and that Mr. W. H. Preece, the engineer-in-chief to the general post-office, was quite satisfied with the result. Mr. Preece has, in fact, long since had a system of wireless telegraphy at work at St. Martin's Le Grand, London, in connection with the general post-office buildings; but the intervening space has been necessarily limited, although intervening bricks and mortar have no effect upon the communication.

Mr. Preece has personally spent a great deal of his

time intermittently upon the experiments in this locality. It seems that a cable was laid across from Lavernock Point, near Barry Dock, to Flat Holm Island, in the Bristol Channel, at an enormous amount of labor and expense, only to find that all had been wasted, because so many vessels drop anchor in these waters that the cable was dragged about and broken within one week from the time it was laid. Consequently, Mr. Preece set himself the task of experimenting with "wireless telegraphy," and under the direction of Mr. J. Gavey, his chief assistant, no effort has been spared in determining upon the best practical method of applying it. With $3\frac{3}{4}$ miles of water space between the points, no better place could be found for practically testing the new system; and, now that the desired communication has been established, the attention of the whole scientific world will be directed to it, and Mr. Preece will doubtless be invited soon to describe his experiments and their results.

The invention of Marconi has become familiar to, although perhaps not fully understood by, the lay mind, the theory having long since been made public property, and it being generally supposed that the system associated with the name of this young inventor would be adopted. But it transpires that Mr. Preece has perfected a system of his own, and has arrived at a satisfactory solution of this great scientific problem of telegraphing through a space of no less than $3\frac{3}{4}$ miles. It should be mentioned that as far back as 1892 the results obtainable were such as to justify the expectation of the desired end, but the various methods tried have all been more or less affected by disturbing influences. The system arrived at may be described as electro-magnetic, and is claimed to be free from such disturbances. The introduction of a very large copper wire and the alteration of the instruments, so as to embody certain desiderata, have been made; and it is stated that no less than forty words per minute have been transmitted without any necessity having arisen for obtaining a single repetition. If this report be true (and there appears to be ample confirmation that it is so), the most sanguine expectations of persons interested in this latest scientific wonder have been fully realized.

The following brief description appeared in a local newspaper on March 29:

"Copper wires of a very large gauge have been erected parallel with each other, one on the sea front at Lavernock Point and one across the Flat Holm, near the lighthouse—3 miles apart—and the Morse code signals transmitted are very distinct. Many improvements in the apparatus have been introduced since the previous trials were carried out, and it is very satisfactory to know that a high speed of working has been attained. The vibrations transmitted through space from the electric motor produce on the telephone receiver a most pleasing tone, and the combination of dots and dashes is easily readable by a manipulator. As many as forty words a minute have been signalled across and read without any difficulty whatever. There can be no doubt that the system of communication now permanently established between the fort on the mainland to the fort on the Flat Holm will mark an important epoch in the telegraphic developments of the century, and Mr. W. H. Preece is to be congratulated on the great success his method has attained. The two methods of so-called wireless telegraphy, which have recently created such widespread interest, were fully explained to a Cardiff audience at Mr. Gavey's recent lecture before the Cardiff Naturalists' Society. The post-office has considered it wise, for various reasons, to establish the permanent communication between Lavernock and the Flat Holm by means of the electro-magnetic rather than by Marconi's system, and, without entering into technical details or criticising the action of the Department in this matter, we can merely say that a thoroughly satisfactory and trustworthy telegraph service is now established between these two points, which, there

is every reason to believe, will be free from the disturbing influences to which other methods are subject."

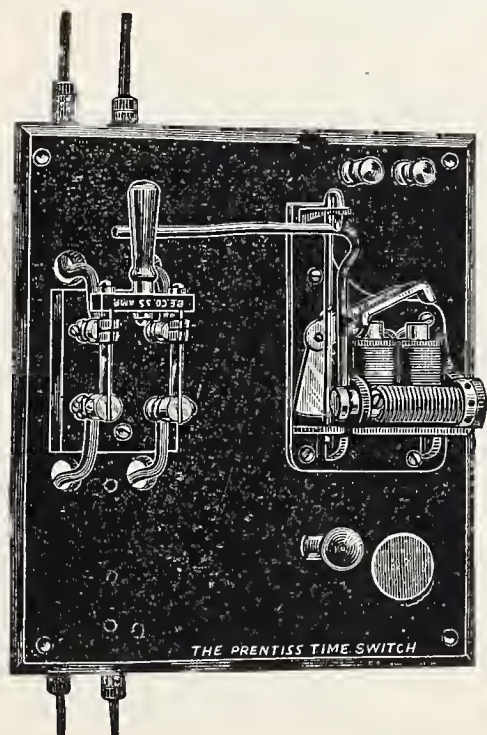
From other sources, I gather that on the mainland a stout copper wire has been fixed, as ordinarily, to poles, the length of the wire being three-fourths of a mile. The ends of this wire run into the sea. On the island a similar wire runs exactly parallel, as previously mentioned, to that on the mainland; and the length of the island wire is about half a mile, with the ends run to earth. It seems that the length of the parallel wires is governed by the extent of the space between them. The transmitting and receiving apparatus are duplicated, and it is said that the system is less costly than that of Marconi; that the parts of the apparatus are not so delicate; and that the necessity of having the instruments practically tuned to a nicety does not enter into its efficiency. The theory of electro-magnetic waves—that when wire A is charged with the current, so is its "field;" and that the circles of waves enlarge until they meet a conductor in wire B, which becomes charged to a certain extent—suggested to Mr. Preece the idea of his method; and the dots and dashes of the Morse system of telegraphy made it possible, the dot requiring a connection of shorter

picked up from the neighboring telephone wires. Thus, his mind was directed to the possibilities of the subject, it being obvious that the influencing of one wire by the current sent through another was inductive. This happened many years ago; but this famous electrician has been patiently experimenting ever since, until at last success has crowned his efforts. The hope of electricians to bring about telegraphic communication between vessels at sea and distant shores seems about to be realized, and soon the "transmitter" and "receiver" will be deemed essential on board every kind of craft sailing on the high-ways of commerce.

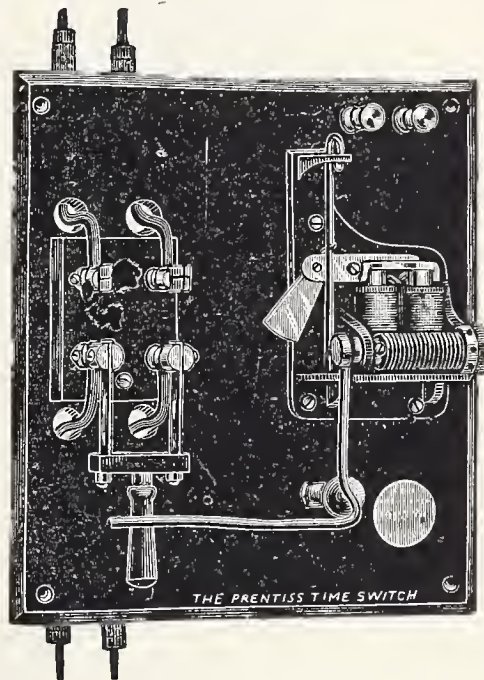
DANIEL T. PHILLIPS,
Consul at Cardiff.

THE MEASUREMENT OF TIME.

The demand for well constructed clocks of moderate price, which will keep good time without too much attention, is constantly increasing. The business of the Prentiss Clock Improvement Co. of 49 Dey street, New York, its improvement in clocks, and the growing favor with which their long-running clocks and automatic perpetual



The Prentiss Time Switch.



duration than the dash; and, as is well known, the arrangement of dots and dashes forms any letter or combination of letters desired.

Ingenious mechanism is attached, by which a clear, musical note—C has been chosen as the best for hearing—is created. By means of a brass circle, in which there is an indentation at every three-eighths of an inch, the current is automatically interrupted at the rate of 250 makes and breaks per second, and when the dots and dashes are made by the operator at one end they may be heard at the other through an ordinary telephone. A great difference between this system and Marconi's is that the messages are read by sound, while in the young Italian scientist's they are recorded. This, I need hardly say, is of no importance; but if it be true that in Preece's system the transmission is no less than four times as speedy, the advantage is greatly in its favor. I may add that, instead of the ordinary "sounder," a telephone arrangement is brought into requisition, and the interpretation of the vibratory signals is said to be quite easy.

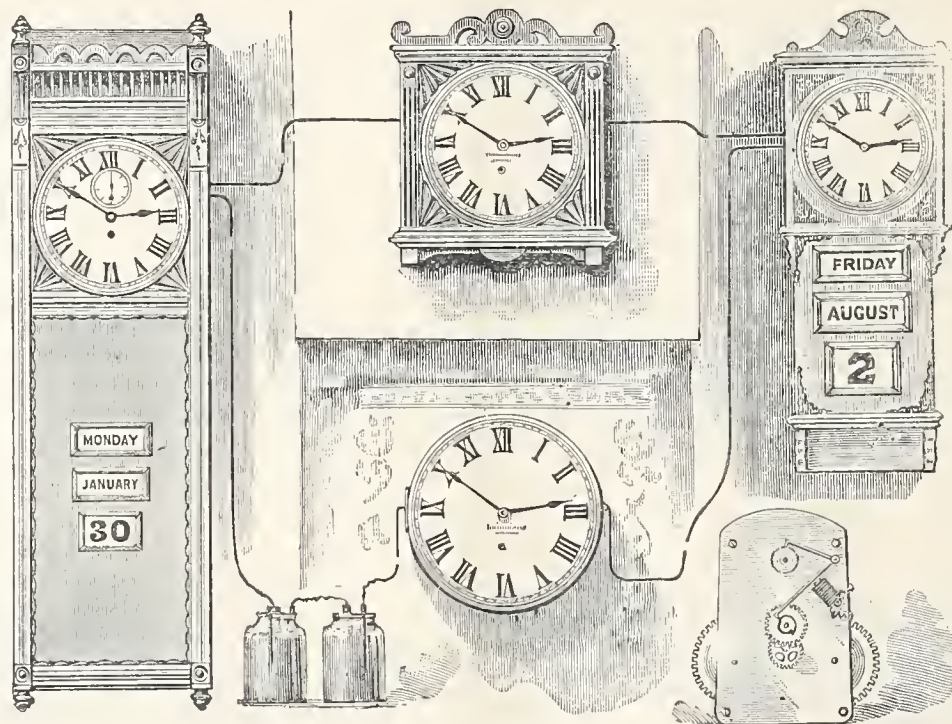
Now that a permanent system of wireless telegraphy for communication through space has been established, a new impetus will doubtless be given to further scientific researches in that direction. It is said that what led Mr. Preece to utilizing electro-magnetic induction was having it brought to his notice officially that, while messages were being transmitted over the post-office telegraph wires in Gray's Inn road, London, sounds could be

calendars are being received lead them to believe that the line which they are following is the right one and that there is abundance of room for these improvements. The effect of Time-Service Systems and Companies, especially in the larger cities, has been to lead the people to demand a higher grade of time-keeping and in consequence a better grade of clocks is required today, by most business concerns, than would have satisfied them some years ago. The importance of time as a factor in business success is becoming more and more apparent and there is every reason to believe that the clocks of 1997 will be better clocks than those of today. However this may be, the Prentiss Clock Improvement Co. believe they are equal to the present demand and that their sixty and ninety-day clocks are the best clocks which have ever been placed on the market when both price and grade are taken into consideration. Their automatic calendar still stands without a single competitor and is pronounced by customers abroad as well as by those in this country the most complete and perfect mechanism of its kind ever yet produced. It only has to be used to be thoroughly appreciated. As it does all that could possibly be required of a date-changing and displaying mechanism there is little room for improvement except perhaps in the direction of the cost of production, which of course depends largely upon the number used. The Prentiss Clock Improvement Co. have also made great improvements in synchronizing and electrical controlling devices,

for producing uniform time, or regulating any number of clocks from a single Master Clock. Though not as well known as their calendar and long-running clocks, it is fast making its way as the most satisfactory and reliable Time-System in use today. It is both simple and low in cost especially in cost of maintenance.

The sixty-day movement sold by the Prentiss Clock Improvement Company was used for many years in the

clocks of the Prentiss Clock Improvement Co. are connected in series as shown in sketch. The clock movement in the right-hand lower corner shows a synchronizer attached to it. The large clock on the left is the regulator and master clock. When a sub-clock is correct and needs no synchronizing it will be seen that the passing of the cam from the high part to the low portion, and the consequent releasing of the lever which permits the

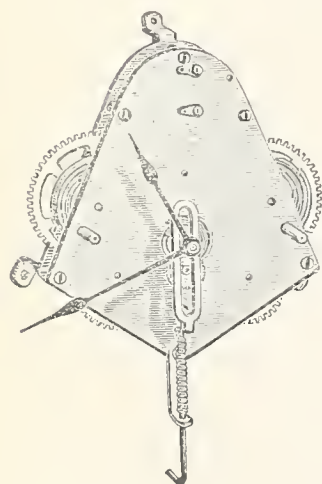


A System of Synchronized Clocks.

time-service of the Prentiss Calendar and Time Company. Its aid had been so great and its reputation so general that those desiring the very best clock movement made have immediately procured the sixty-day movement. It possesses two springs; the winding is performed with a small crank-key and requires attention but six times a

armature to act, is simultaneous with the opening of the circuit by the master-clock, and that therefore no effect is produced.

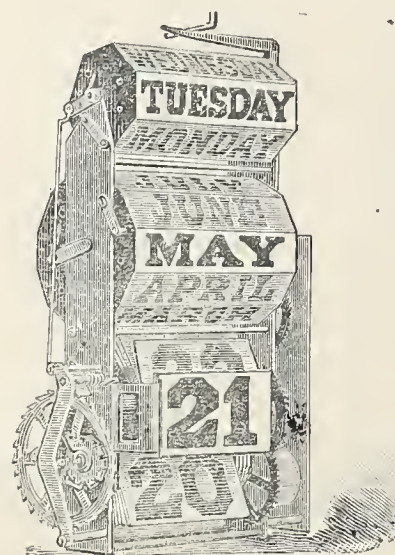
A complete description of a synchronized plant of time keepers may be obtained from the catalogue of the above company. Several other types of clocks are mentioned,



Prentiss Sixty-Day Movement.



Independent Empire Calendar



Calendar Movement.

year; it is fitted with a dead-beat escapement. The qualities of this movement and the framework in which it is held are durability and reliability for long runs. The calendar movement is a distinct piece of mechanism. By pulling a cord or touching an electric button it is operated immediately. The date is automatically recorded, the apparatus being rewound but once a year.

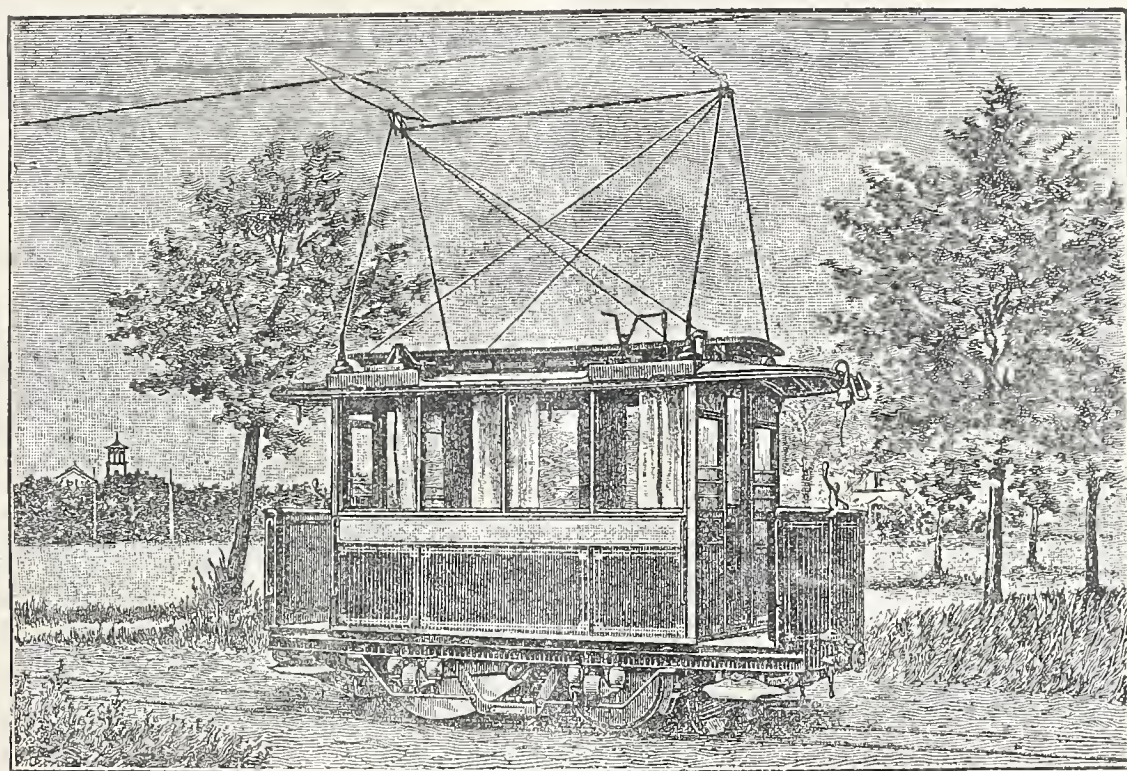
The calendar is perpetual and consequently cannot be criticised for its duration of action. The synchronized

manufactured and sold, thousands of which are in use all over the United States and European countries. The time-switch manufactured by the Prentiss Clock Improvement Company represents an automatic device for turning off incandescent lamps at any appointed time. A single cell of dry battery will operate the switch, provided the clock is in the near vicinity by whose means the switch is indirectly operated. The switch does not arc but acts instantaneously. It is fireproof and finely

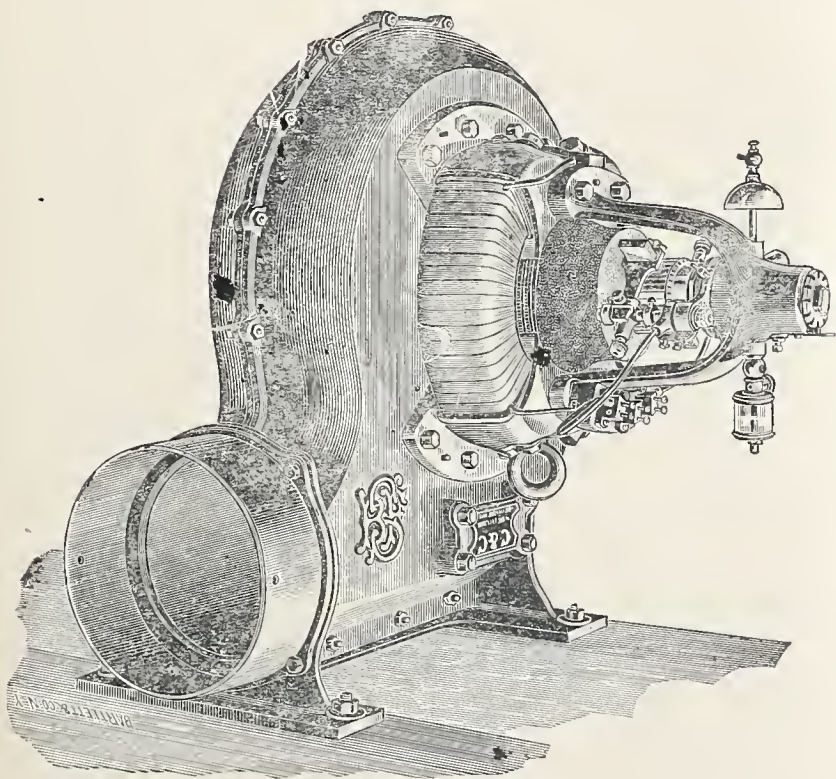
finished, and has met with wide application. For store and window lights, buildings and public institutions, the time-switch has been approved by the Fire Department and underwriters of New York City.

The above company have recently secured the contract for the Newark High School, in which a full system of clocks, including one master-clock, one programme clock with ten circuits, each circuit operating bells in different rooms, etc., is being installed. In addition a telephone system, connecting principal with teachers, greatly adds to the convenience of the pedagogues. An identical system is now being shipped to the High School at Springfield, Mass., with the exception of the telephone.

fulfil certain functions. In earlier days Page made a motor which depended upon the suction or attraction of a helix for a soft iron core. The entire mechanism otherwise represented the details of a steam-engine. The slide-valve was duplicated by means of a contact-piece. Although the apparatus rotated, producing power and motion, it was not efficient, or at present more than historically interesting. From the first experiment of Ørsted sprang a host of inventions. Jacobi, working under the patronage of the Czar of Russia, built a small boat run by a motor which was used on the river Neva. In Germany many machines were produced that clearly showed the easy transformation of electric into mechanical energy.



Early Style of Trolley Car.



Electric Blower.

ELECTRIC MOTORS AND THEIR APPLICATIONS.

(Continued,)

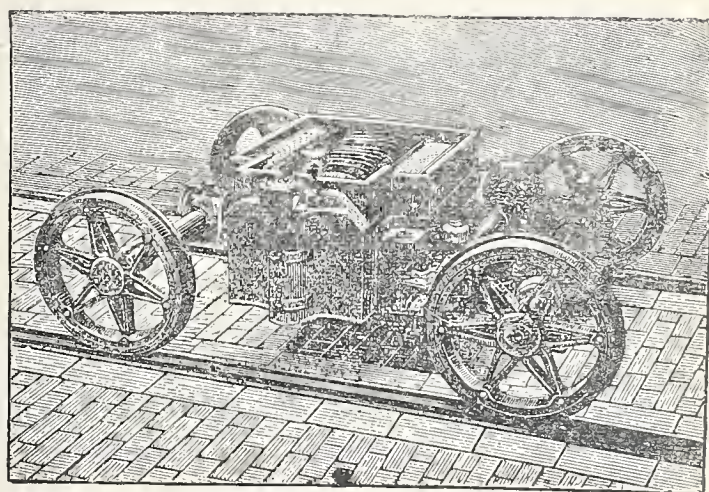
LESSON LEAVES

FOR

THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

A motor to satisfy the demands of modern design must



Early Electric Truck.

In America, Froment and others set to work constructing small motors for practical purposes. A motor is today the most efficient machine in existence. Its principle of action is not less interesting than singular. In one respect it departs from the regular beaten path in utilizing power in a unique manner. Stripping the machine of all elaborations, it is to be seen that the attraction and repulsion of magnetic poles causes the rotation. It is necessary to have in every motor a source of magnetic power. No matter how rude the construction, this is an essential part of the device.

A bar of iron may be rotated in front of this magnet, attracted to a certain point, and then by means of its own momentum allowed to swing around and present its other end for attraction. In so simple a contrivance we have the elements of a modern motor. To enable the current to act in order that the magnetizing effect is auto-

atically supplied when needed, a commutator is used. A switch which controls the current, acting by means of rotation, is the addition required. In large motors the field is kept constant. When the motor is started the field is the first part energized. The necessity for this will be explained later on. When the field is ready, rotation of the armature ensues as soon as current is let into it. The armature consists of a cylindrical body of iron upon which is wound coils of wire. These coils are connected to a commutator so that they are each individually attracted in rotating through the field. The armature is nothing more nor less than a compact form of magnet with innumerable poles.

If the armature rotates in a magnetic field, it does so because each of these coils individually are attracted by the current; this is effected by having a series of metallic strips composing the commutator connected to the ends of each coil. When these coils are made magnetic they move towards the nearest oppositely magnetized pole piece and rotation at once ensues.

This process is regularly occurring with every coil, and results in a rapid and even spinning of the armature.

In considering the dynamo it was observed that the conductors cutting lines of force generated an electromotive force. In a motor we also have conductors cutting lines of force; therefore an electromotive force is likewise produced.

It is necessary to appreciate this fact in order to understand the scientific meaning and bearing of the term efficiency. If the electromotive force generated in a motor while rotating were by any possibility equal to that supplied the motor would stop. There is always a difference between them, however, which depends upon the load of the motor.

If 100 volts were applied to the motor it might generate within its armature 90 volts; therefore only 10 volts can be effective in forcing current through it. The resistance of the armature must be low enough to allow sufficient current to pass at 10 volts' pressure to do the work required. This adjustment is constantly occurring between the load on the motor and the pressure generated within it. In this respect a motor is perfectly automatic and requires but little outside aid in certain types to overcome many difficulties hampering the speed.

The pressure created in the motor by its armature rotation is called counter or back E. M. F. The ratio existing between the counter and applied E. M. F. is a measure of the electrical efficiency of the motor.

$$\frac{\text{Back E. M. F.}}{\text{Applied E. M. F.}} = \text{Electrical Efficiency.}$$

The more rapidly a motor speeds up the greater becomes the counter E. M. F. with a constant field. The back E. M. F. becomes more and more identified with the applied E. M. F.

The armature takes less and less current, and in electrical efficiency the motor approaches its ideal value.

The commercial efficiency is the ratio existing between the power obtained from the motor and the power applied. A motor cannot have a high commercial efficiency with a low electrical efficiency.

$$\text{Commercial efficiency} = \frac{\text{Power received}}{\text{Power applied.}}$$

Each watt entering the motor equals 44.2 ft. lbs. The power applied can therefore be calculated. The power received from the pulley of the motor is obtained by means of a brake. It also represents foot pounds. In large motors this may be equal to 90 per cent.; the electrical efficiency may equal 95 per cent. in the same machine. To test a motor its load is entirely applied and the volts and amperes it consumes measured. The speed of the motor is taken and the pull in pounds measured on

the periphery of the pulley. If the following data be considered the process will not be confusing.

Test of a motor. volts, 100
amperes, 10,
speed, 2,000
pull, 5 lbs.
pulley = 1 ft. diam.

$$\text{Power entering} = 10 \times 100 = 1,000 \text{ watts.}$$

$$= 44,200.0 \text{ ft lbs.}$$

$$\begin{aligned} \text{Power received} &= \frac{\text{Circumference of pulley} \times \text{speed} \times \text{pull}}{33,000} \\ &= \frac{3 \text{ ft.} \times 2,000 \times 5}{33,000} = \frac{30,000}{33,000} \\ &= \frac{9}{10} \text{ H. P.} \end{aligned}$$

The commercial efficiency therefore is quickly found.

$$\frac{\text{Power received}}{\text{Power applied}} = \frac{9 \text{ H. P.}}{10 \text{ H. P.}} = 90 \text{ per cent.}$$

QUESTIONS FOR REVIEW.

- (1) What causes rotation in a motor?
- (2) What is back E. M. F. ?
- (3) State the conditions of highest electrical efficiency.
- (4) Upon what does commercial efficiency depend?
- (5) How is the commercial efficiency of a motor calculated?

MAGNETS AND ELECTRIC CURRENTS.

A most complete volume treating of the principles and applications of electricity has been published by Spon & Chamberlain. It is written by J. A. Fleming, M. A., D. Sc., F. R. S., who has already distinguished himself by a volume entitled, the "Alternate Current Transformer," a work much quoted in technical circles. The value of this later volume is highly evident from a general survey of its reading pages. The subject of magnetism in all its phases is carefully considered and considerable space is devoted to the subject of electrical measurements and the definition of units. Under the head of electromagnetic induction, which is certainly a most important department of electrical engineering, a great mass of information is presented of the highest value to the technical student and practical engineer. A great deal of original matter relating to alternating currents may be found in the latter portion of the book and considerable information of a most practical nature is given in chapter X, entitled, "The Generation of Electric Currents." The book is a pleasure to read and represents much labor and care on the part of Mr. Fleming to obtain the proper arrangement of each subject and a presentation of principles that are backed up by useful and interesting matter of a character that will withstand criticism. To those already acquainted with the different departments of electrical engineering this volume will appear in its strongest light. To others just entering into a study of the science it will prove a valuable helpmate and ready reference.

Peterboro, Ont.—Mr. D. A. Starr, manager of the Cornwall Electric Railway Company, submitted to the town council at its last meeting a scheme for the construction of an electric railway from here to Chemong and Lakefield. The Company propose to lease the Chemong and Lakefield lines from the G. T. R., convert them into electric roads, and take over the freight business. The cost is roughly estimated at \$350,000.

The Electrical Age.

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COPPER MINES IN THE PHILIPPINES.

The present war has brought to the attention of Americans the fact that in Cuba and the Philippines great beds of mineral deposits may be found whose extent and value can scarcely be estimated. Spanish rule has never possessed those qualities which lead settlers to investigate and probe the earth for mineral wealth. The islands of the Philippines, especially, have been regarded more as vast tropical growths than as the possible centre of great mining industries, of large manufacturing concerns, and the site of great plantations. To the electrical profession the Philippine Islands are particularly interesting, because it is very likely that the protectorship exercised over them by the United States will be of such a nature as to lead to the development of her mining industries, which will be of large extent.

Mr. Frank Karuth, F. R. G. S., president of the Philippines Mineral Syndicate, Limited, in a letter to Ambassador Hay, states as follows:

"Copper is found in many parts of the Philippines and cupreous pyrites are not unfrequently met with, accompanying quartz veins, but in such small quantities as to exclude all commercial value. In the central mountain ranges of Luzon, however, between Cagayan and Ilocos, considerable deposits of copper are distributed and have been worked by a tribe of natives called Igorrotes, long before the advent of the Spaniards. They obtained the ore in excavations which they made with the aid of wood pliers, thus softening the rock. They separate the ore according to quality and roast the poorer repeatedly before smelting it. Their furnace is a cylindrical hole walled with clay, about twelve inches deep and eight inches in diameter, and they use blowers of bamboo worked with plungers to produce the requisite draft. A Spanish company was established to work these deposits

on a large scale. Furnaces were built, machinery was put up, but what the natives could accomplish the European metallurgists failed to do, although in those days copper was worth over \$500.00 per ton. The absence of roads told, and the enterprise eventually collapsed."

By these remarks our electrical friends can very readily judge of the latent possibilities, from the mining standpoint, of these islands. They seem to possess in an ideal manner all the requirements for the establishment of great electrical enterprises. Coal is to be found in abundance of the lignite order, plenty good enough for smelting copper or running electric light plants. The Philippines Mining Syndicate are now using this lignite for the operation of their steam engines. The coal is rich in carbon and burns well. It seems very likely that in the near future many manufacturing electricians will have good cause to visit Manila for the establishment of trading centres for purposes of manufacture. There are great gold fields on these islands, and from superficial investigation there seems to be plenty of other minerals to be found.

The Philippines of ten years hence will be so different from what they are now, with the addition of new blood and Yankee enterprise, that there will be not as great a contrast between the days of '76 and the close of this century as between Manila that was and Manila that will be.

DR. G. S. OHM.

When a great natural law is discovered it is as the result of careful thought and prolonged observation. It has never been the result of accident and has never been given voice to on the spur of the moment. There are only a few great laws underlying the framework of modern science, and from these laws have sprung various ramifications which lead to a-thousand-and-one channels of investigation. It requires a keen instinct and those powers of observation which only occasionally appear in men in order that they may follow out some great law or trace through a series of phenomena the influence of some predominant principle. It is somewhat surprising to realize the modesty possessed by those who have immortalized themselves in fields of science, art and literature.

Dr. G. S. Ohm, in his preface to the little book containing the discovery and interpretation of the great law bearing his name, states as follows: "I herewith present to the public a theory of galvanic electricity as a special part of the electrical science in general and shall successively as time, inclination and means permit, arrange more such portions together into a whole, if this first essay shall in some degree repay the sacrifices it has cost me. The circumstances in which I have hitherto been placed have not been adapted either to encourage me in the pursuit of novelties or to enable me to become acquainted with works relating to the same department of literature throughout its whole extent. I have therefore chosen for my first attempt a portion in which I have the least to apprehend competition. May the well-disposed reader receive the performance with the same love for the object as that with which it is set forth."

Dr. Ohm seems to have half believed that his invaluable treatise might not be well received by his confreres. We can best judge of that at the present day and marvel at his wonderful simplicity in offering his great work diffidently to the scientific world.

WALTER K. FREEMAN, the electrician, who was tried and convicted before Justice Smyth and sentenced to Sing Sing prison for seven years, was discharged from custody June 29th by order of the Court of Appeals. At the time of his trial he alleged that the case against him was the result of a conspiracy formed by a business rival. —N. Y. "World."

ELECTRIC RAILWAYS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E.E.

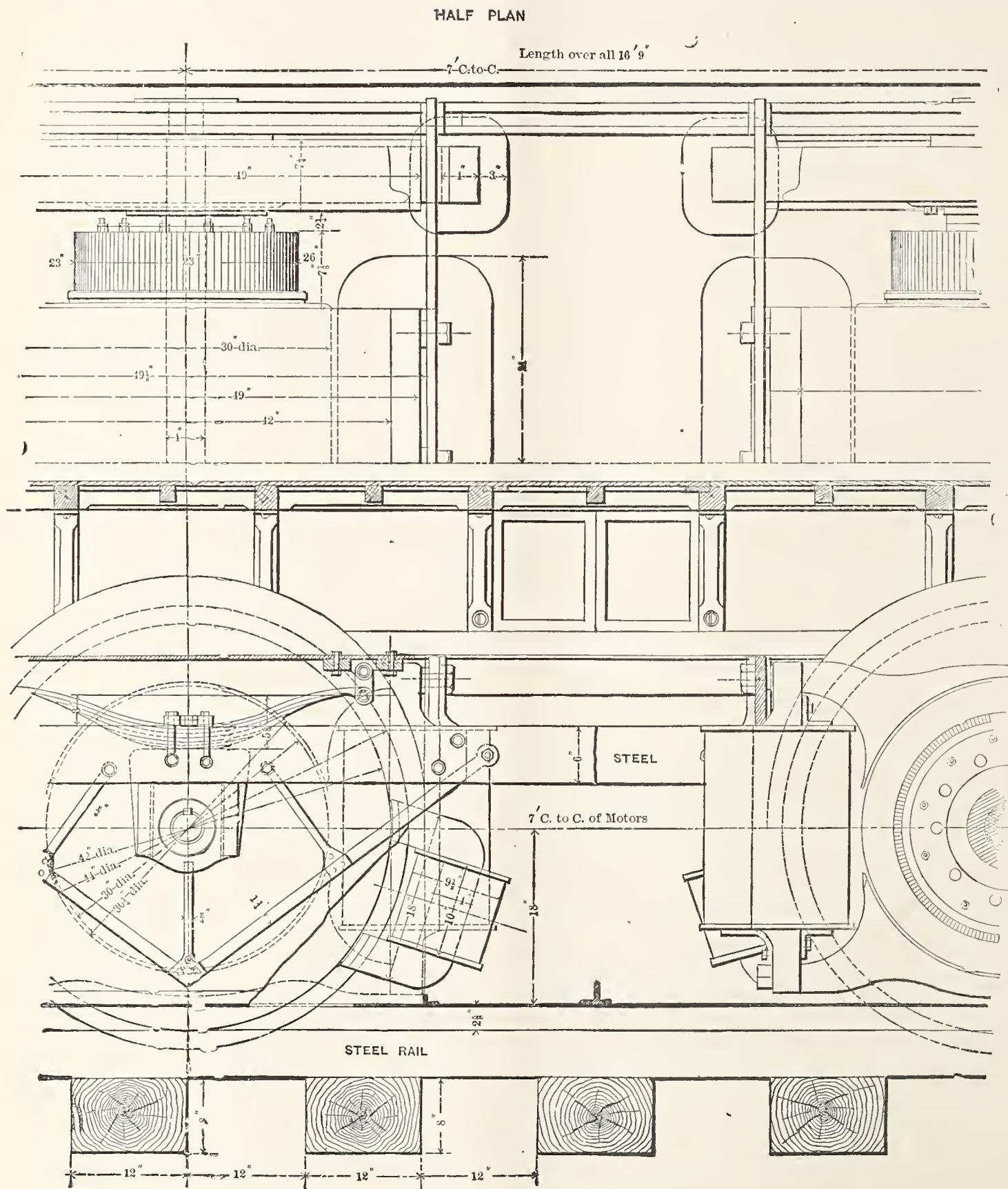
Many systems of railroading have been attempted in this country. The labors and extensive experiments of

SYSTEMS:

The Trolley,
Conduit,
Block,
Storage battery.

STORAGE BATTERY CARS.

Several combinations of the above have occurred, such as a block-storage battery system of Johnson and Lun-



Plan of Electric Road; Speed 150 Miles an Hour.

Siemens in Germany, Edison, Daft and Sprague of America, were not always crowned with success. The difficulties that beset the path of the inventors, the poorness in one sense of the mechanism, and the difficulty of obtaining the proper materials, greatly prevented them from progressing with any rapidity. The result of their efforts has been, as we well know, very successful from a practical standpoint. The electric railway of to-day is but part of a vast system that will replace all else and whose lines will reach from the Atlantic to the Pacific. The systems of railroads that have been tried with more or less satisfaction are contained in the following list:

dell. A method once suggested was that of having steam and dynamo plant on the train and feeding direct to the motor beneath. This was thought far superior in efficiency to the use of a steam locomotive, whose record of usefulness does not exceed four per cent. The diversity of opinions existing relative to the gain and excellence of different systems hardly exist at present. The storage-battery traction method would be first-class if the storage battery were not so heavy, less troublesome to handle and a little more efficient in delivery of power. The trial made with these cells and other hybrid types has been in this city, at least, without other than temporary success.

The trolley, conduit and block systems carry only the motor, but the storage-battery car moves along dragging at the same time a ton or more of cells. These cells do not pay any fare and necessitate extra contrivances for their hasty transfer from car to station or the converse. Many managers of bankrupt companies could supply eloquent testimony in relation to the subject.

CONDUIT.

Germany has enjoyed the privilege of having within its confines one of the few successful open conduit electric roads in the world. It had the first. The desire to emulate the example of German engineers caused several subscriptions in that direction which in this country last year signally failed. The development of a railroad scheme having a conduit road as its basis was looked upon as impossible. An open slot cable conduit differs in no particular from the cavity used for electrical purposes. Two conductors, insulated as carefully as possible and protected from the drippings that might corrode and injure them, are laid within side by side. A trolley wheel slide or equivalent arrangement takes current from the wire to the motor above.

As far as the running of the system is concerned, it has proven a success. The financial end is not open for public inspection. The travellers who employ the car from point to point express satisfaction, so that from a popular point of view the road is all right. The future of this road embraces that of many others. The trolley is dispensed with and the wholesome objections of municipal authorities to all external appliances. The leakage within the conduit may be brought to a minimum by having large, open and frequent sewer connections. The drainage is thus rapidly removed, and the only loss of power is that due to the moisture and condensation on the exposed wires and their supports.

Napanee, Ont.—The town council have accepted a proposition made by John R. Scott to supply electric light. Mr. Scott agrees to install an incandescent and arc plant within one year.

Bridgetown, N. S.—A company is being formed to supply electric light generated by water power. It is proposed to lay an iron pipe $\frac{5}{8}$ of a mile in length. Curry, Bent & Co. are interested.

ELECTRIC TRACTION.

NOTES ON THE APPLICATION OF ELECTRIC MOTIVE POWER TO RAILWAY SERVICE, WITH ILLUSTRATIONS FROM THE PRACTICE OF THE METROPOLITAN ELEVATED ROAD OF CHICAGO.

BY M. H. GERRY, JR.

In the following paper will be found a brief discussion of some of the more important problems arising in connection with the application of electric motive power to the heavier classes of railway service. A number of tests and diagrams from the Metropolitan Elevated Railroad of Chicago are introduced by way of illustration.

A part of this paper relates especially to the application of electric power to passenger rapid transit on elevated and suburban roads. The conditions for this service differ somewhat from common railway practice. Regular stops are made at frequent intervals; the distance between stations on elevated roads, for example, averaging about 2,000 feet. The interval between trains is small, and the time of stops very short. The traffic is irregular, is heavy at certain hours, and is apt to increase and decrease at a rapid rate. To make the fast running time desired, the speed must increase up to the point where the brakes are applied; thus the maximum of speed

is high compared with the mean speed. There is little or no opportunity for maintaining the speed, and the running time depends almost entirely upon the rate of accelerating and retarding of the train.

With a given number of stops per mile, the amount of power required will increase very rapidly with the speed beyond a certain point, and the cost per car mile will not furnish a reliable basis of comparison for the motive power of different roads unless the conditions are the same. A slight difference in the average speed, or in distance between stations, may cause a considerable change in the amount of power required.

There are in operation at the present time several noteworthy examples of the application of electric motive power to the heavier classes of railway service. The most important of these installations are the Lake Street and the Metropolitan Elevated Roads of Chicago, the Baltimore Tunnel Line of the Baltimore and Ohio, and the Nantasket and Berlin lines of the New York, New Haven and Hartford Railroad. From the experience gained on these roads, there is no longer a question in regard to the ability of properly designed electric motors to operate trains of the heaviest weights in service, and at any speed permissible under practical railroad conditions. In the future, matters of efficiency and general utility must determine the desirability of electric power for any particular railway service.

Certain operating conditions have a special bearing on the efficiency of this form of motive power; the most important being the frequency of the train service. If traffic is such that a large number of trains must be operated on a division, the electric power will have an advantage, in point of economy, over steam locomotives; and if the trains are few, the reverse will be the case. This condition holds good independently of the weight of the trains or of the speed attained. The length of the line is in itself no bar to the successful operation of an electric railway system, as, by using alternating current apparatus, the power stations may be located favorably, and at long distances apart.

The distribution of current to the trains, while it presents many practical difficulties in detail, is not so serious a problem as it was thought to be at one time. Of the three systems of over-head conductor, conduit, and third rail, the last has given the best results, and is advisable wherever the conditions are such that it can be installed. For roads operating on their own right of way, there is really no serious objection to the third rail, and all of the difficulties encountered at crossings, switches and in yards can be overcome by methods already in use on the roads named above, or by other devices that have been proposed. It is not to be expected that all details of such a system are in an entirely satisfactory and final form, but they are practically operative at present and being constantly improved as difficulties develop in service. The experience already gained also justifies the statement that a reliable overhead or conduit system for heavy service can be constructed if the conditions favor the use of such methods.

The Metropolitan Elevated Railroad.

This system, now in its second year of operation, is the largest road in existence employing exclusively electric power for a heavy passenger service.

The structure has four tracks, from Market street west to Marshfield avenue, at which point three double-track lines diverge. The northerly branch divides again near Robey street into two double-track branches. From Market street to each of the terminals the distance is about six miles. (See map, Fig. 1.)

Current is conveyed to the trains by the third rail system; the "trolley rail" being placed 20 1-8 inches outside and 6 1-4 inches above the running rail. It is of the common "T" section, bonded with leaf copper bonds, and divided into sections to provide for expansion. The in-

First, that required to overcome inertia and accelerate the train to its maximum speed after each stop. Secondly, the energy required on account of ascending grades. Thirdly, that required to overcome train resistance, including friction, air resistance, etc. If the stations are far apart, the energy required to accelerate the train may be neglected without serious error, but for a

The horizontal effort or drawbar pull required to produce a certain acceleration in a given time may be obtained from the mechanical formula,

$$f = \frac{w v}{32.2 t}$$

The work done in ascending grades is the product of

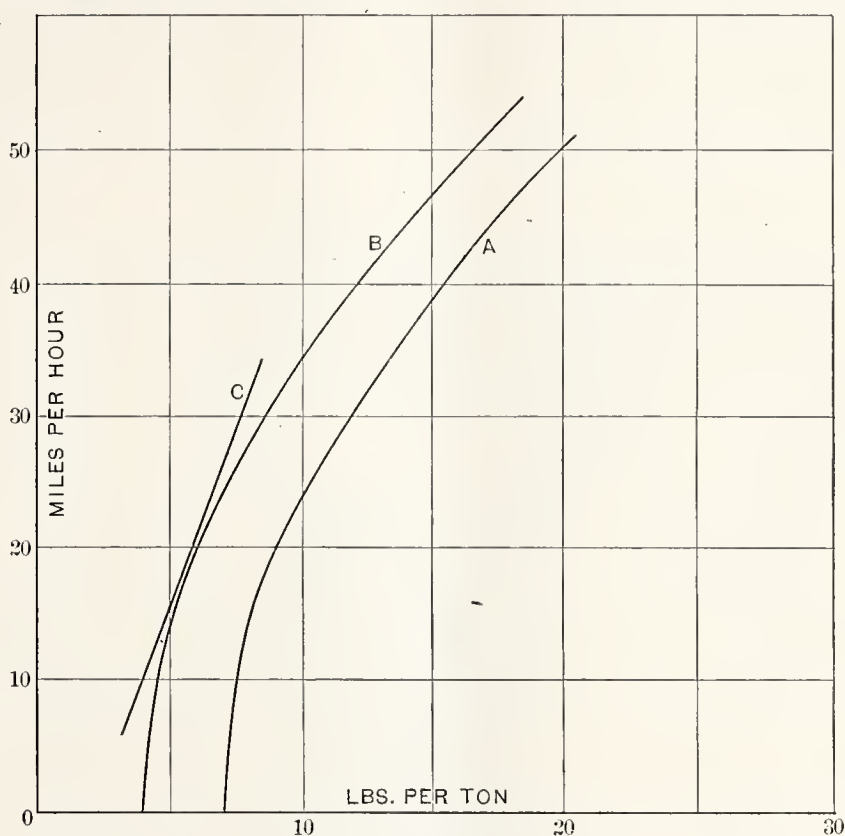


Fig. 2.

service where trains make frequent stops, and the maximum speed is high, compared with the mean speed, it becomes of importance, and may easily be the greatest

the train weight and the vertical distance the train is lifted. The horizontal effort required to take a train up a grade is equal to the product of the train weight by the

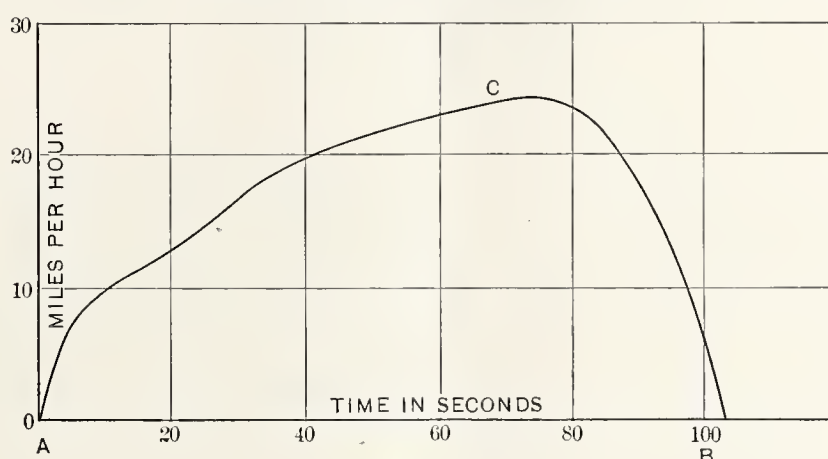


Fig. 3.

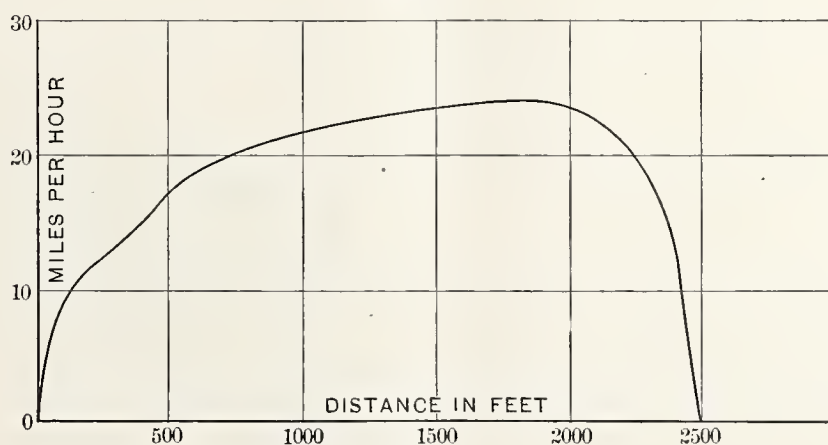


Fig. 4.

of all losses. The amount of energy required for train acceleration obviously depends upon the number of stops, the train weight and the maximum speed. Knowing these quantities, it can be readily determined from the common mechanical formula for kinetic energy:

$$U = \frac{w v^2}{64.4}$$

per cent. of grade.

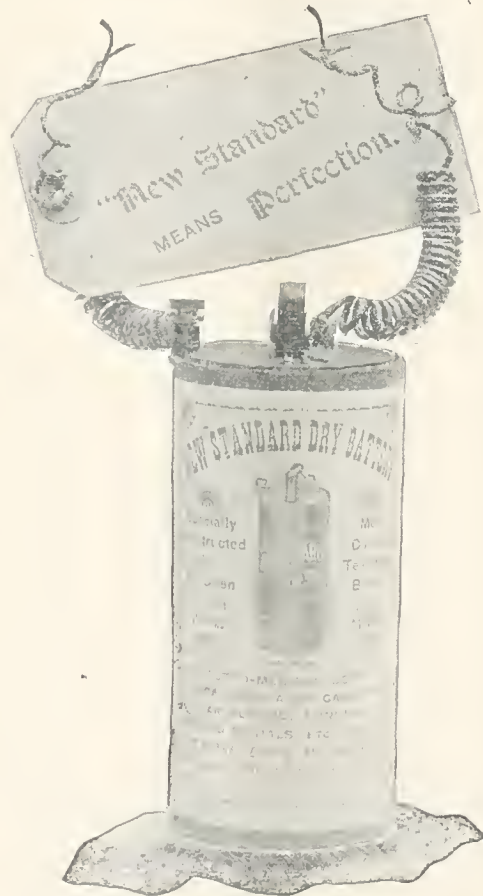
Train resistance, as used in this paper, includes all retarding forces other than those due to inertia and grades. Formulas for determining this quantity are empirical and are based upon experimental results, where the conditions have varied widely. D. K. Clark, in "Railway Machinery," recommends a formula which, reduced to

tons, of 2,000 pounds, becomes $R = 7.1 + \frac{v^2}{192}$. An-

other formula in use is $R = 4 + \frac{v^2}{200}$, where R = resist-

ance in pounds per ton of train weight, v = speed in miles per hour. These two formulas have been plotted in Fig. 2 and are marked respectively A and B. From measurements taken on the Metropolitan Elevated, the curve

the Navy Department for exploding bombs and mines. At many points the cells are permanently connected with mines in harbors and channels to guard the cities bordering on the same against any hostile invasion. This dry battery has been carefully tested by the experts of the Navy Department and found to be greatly the superior in strength of test and long life. Mr. Roche manufactures batteries of all styles and sizes for all applications. They range in size from a battery no larger than your finger to one the size of a barrel, if you need it. The standard size is the bell battery.



New Standard Dry Battery.

C has been determined and is used in the following discussions.

In Figs. 3 and 4 are shown actual speed curves on a time and a distance base for a train running between stations 2,500 feet apart. For the purpose of discussion, consider the train weight as 100 tons and in the first case assume it to be on an ascending grade of $\frac{1}{2}$ of 1 per cent. From the curves, the speed at the time the brakes are applied is 24 miles per hour, and the kinetic energy at that speed, for the train, is 3,800,000 foot pounds. The time consumed up to the point where brakes are applied is 77 seconds, and the energy to overcome the 0.5 per cent. grade while the train is passing over the first 1,900 feet is equal to 1,900,000 foot pounds.

(To be continued.)

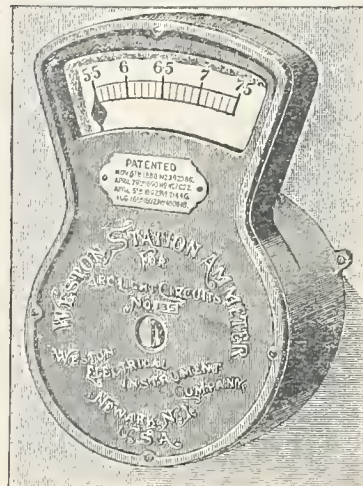
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Secretary Long of the United States Navy had his attention called to a description of the New Standard Dry Battery, published in the "Electrical Age" last spring, and since then several thousand cells have been used by

It will be remembered that it was Mr. Roche who made the "Exeter" dry battery, which was selected out of several hundred different makes for use at the World's Fair at Chicago in 1893. It was used with the "Victor" key by President Cleveland to open the exposition. Mr. Roche manufactures dry batteries for the trade in general and will put on any trade mark requested by buyers. He is one of the broadest-minded men in the dry battery business, and his success has been mainly due to his liberal American ideas.

Henderson, Tex.—J. T. Wilkerson, of Pittsburg. Tex., has established a telephone system in Henderson, and will extend it to nearby towns soon.



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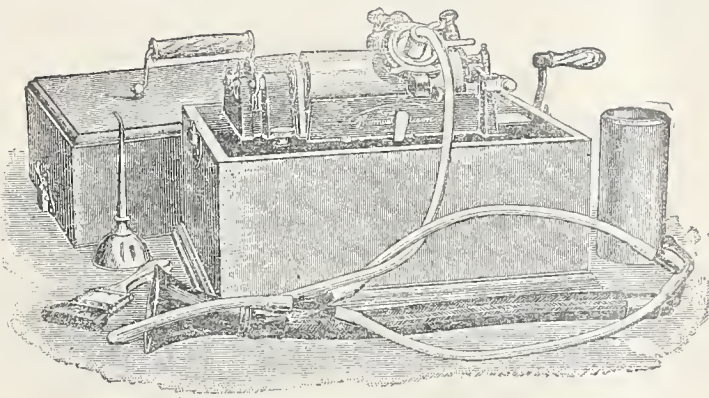
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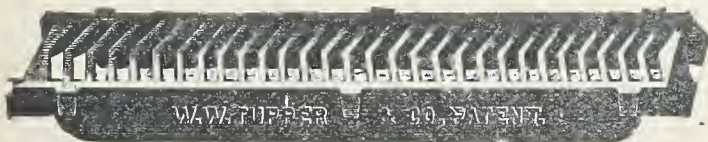
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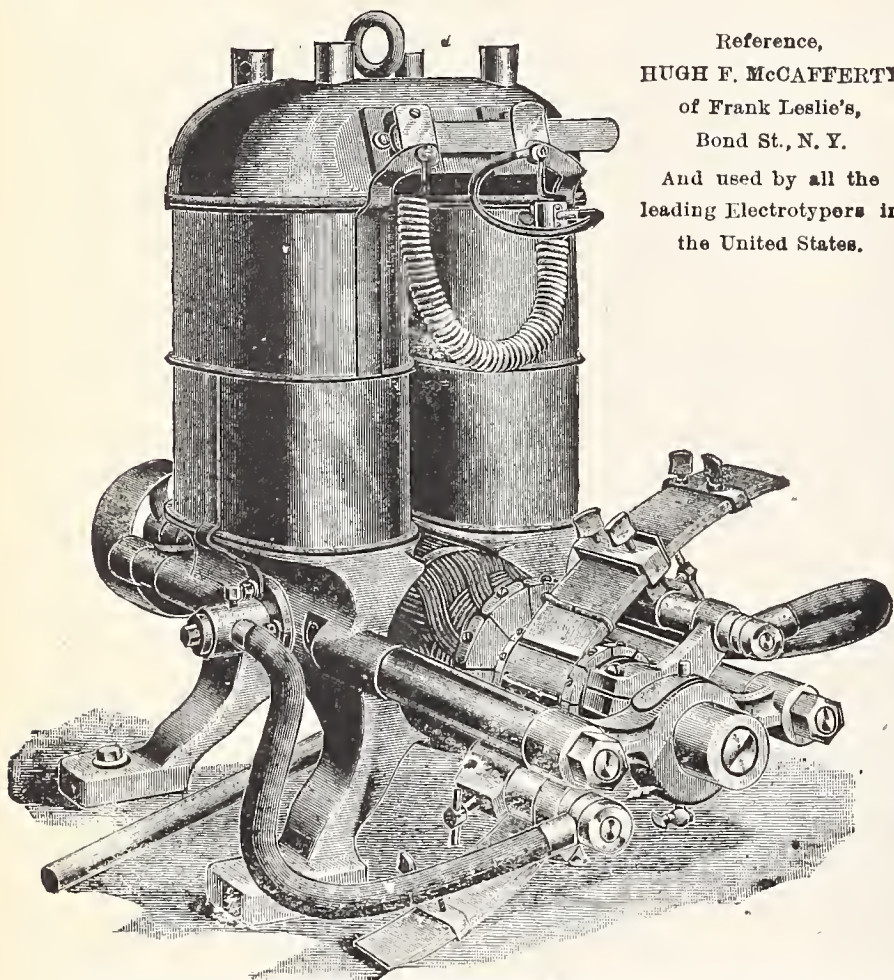
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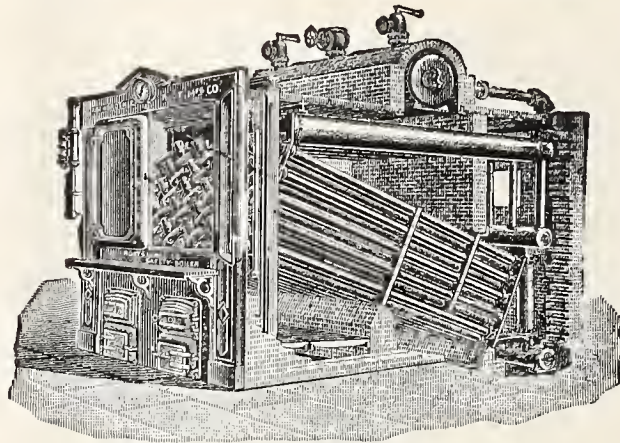
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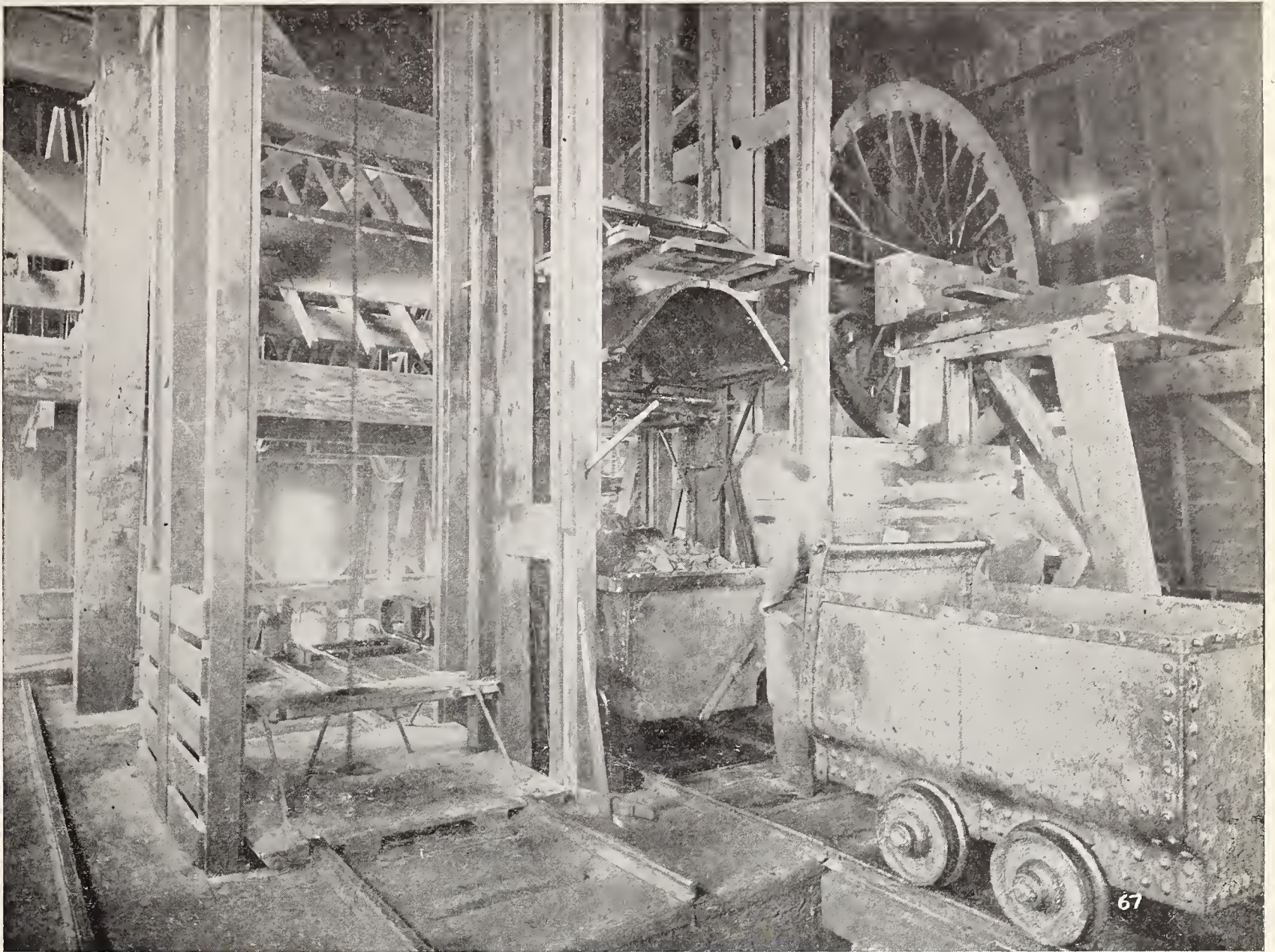
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The Electrical Age.

VOL. XXII—No. 3

NEW YORK, JULY 16, 1898

WHOLE No. 583



Tamarack Copper Mine, Michigan.—No. 2 Shaft House.

SOME NOTES ON A LAKE SUPERIOR COPPER MINE.*

The illustrations given herewith are from photographs taken above and underground in the Tamarack Copper Mine, in Michigan. The first view shows the interior of No. 2 shaft-house, with a car of rock on the cage. The usual time for raising the cage from the bottom of the shaft, 3,775 ft., is one minute. The second illustration shows the sixteenth level plat at the same shaft, with a mine car carrying three tons of rock ready to run on the cage. The third photograph shows tramming in one of the deep levels.

The Tamarack Mine has at present the distinction of having the deepest mining shafts in the world. There are five shafts, No. 1 being 2,240 ft. deep; No. 2, as just mentioned, 3,775 ft.; No. 3 is 4,526 ft.; No. 4 is 4,450 ft. deep, and No. 5, which is now down 2,450 ft., will be, when completed, nearly 5,000 ft. in depth. The company's property is immediately west and north of the Calumet & Hecla's, and it was forced to sink deep vertical shafts in order to penetrate the copper-bearing conglomerate in its downward dip of about 38 degrees. No. 3 shaft reached the lode at a vertical depth of 4,185 ft.; No. 4 found it at 4,393 ft. The first shaft sunk, No. 1, was further north than Nos. 3 and 4, and struck the conglomerate sought at a depth from surface of 2,270 ft.

There has been no sinking at No. 1 shaft for several years, it having reached the Calumet & Hecla line in its

descent. It is 2,240 ft. deep. No. 2 shaft, 600 ft. north of No. 1, is at the 25th level. The lower seven levels have been opened up north and south of the shaft, but there has been but little stoping done. An important work has been begun here in the sinking of an incline shaft located between Nos. 1 and 2. East of the Calumet conglomerate about 100 ft. is a belt of amygdaloid having a thickness of 100 ft. It follows down under the conglomerate regularly, having the same dip, and Captain Parnall, the superintendent, has decided to sink a three-compartment shaft in it. Crosscuts have been driven to it from the 17th, 18th, 20th and 21st levels of the conglomerate belt. The ground is firm, and the shaft will be a substantial one. It will be carried down under the conglomerate and connect at the different levels with the latter. The vertical shafts as they go down are farther away from the lode at each additional level, necessitating very long crosscuts, about 1,500 ft. at the bottom of the mine in this territory. The dip of the lode is about 37 degrees, and takes the latter from the vertical shaft rapidly. Levels are about 80 ft. apart, vertically, and about 133 ft. on the incline. The cost of driving the long crosscuts is a heavy one, the tramming distance is too great, and then it takes time to connect the shaft with the lode. By following down in the amygdaloid belt referred to, the crosscuts will be short, all of the same length and all of the mineralized lode can be taken.

* Loaned through courtesy of Engineering and Mining Journal.

No. 3 shaft, 4,200 ft. north of No. 2, is now 4,526 ft. deep and 14 levels have been opened. The method of opening at No. 3 agrees with that being followed at the lower levels of No. 2. They carry their main drift and a cutting-out stope to the boundary of the property and then stope out the ground from the extreme ends of drifts to shafts, letting the hanging come down after the rock holding copper has been taken. The lode in this portion of the mine is very wide, running from 20 to 25 ft. It is seldom all copper-bearing, and there is no regularity as to the coppery and barren places.

No. 4 shaft, 700 ft. north of No. 3, is 4,450 ft. deep. But little work has been done here the past year. No. 5 shaft is the one that is sinking for the lode and was started the latter part of the year 1895. It is located 3,300 ft. south of No. 4, is five-compartment, 27 ft. 5 in. by 7 ft. 2 in. There will be four cage-ways and a ladder and pipe way. It was sunk 1,029 ft. during 1897, which is excellent work. It is expected to strike the lode at a

The copper yield was 1.65 per cent. of the rock stamped. The total cost of working in 1897 was \$2.07 per ton of rock stamped.

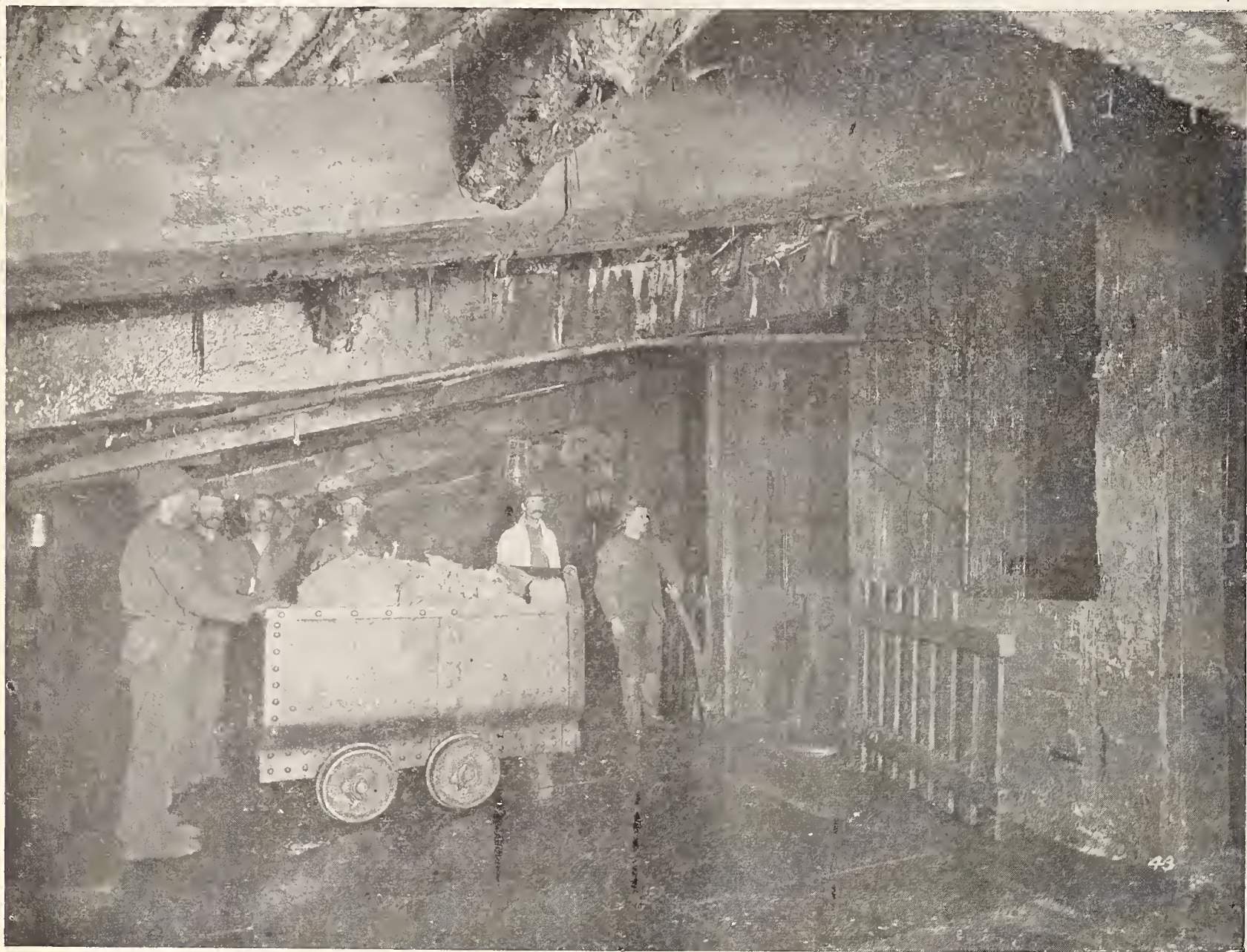
The new stamp mill of the company has seven heads, all with solid foundations and 20 in. cylinders. The daily performance per head for actual running time was 332.95 tons per day.

HOW BRITAIN HAS LOST THE ELECTRIC TRACTION TRADE.*

BY E. F. VESEY KNOX, M. P.*

During the past ten years the United States have, by the policy of "free streets," created an industry nearly as great as the trade which Great Britain has secured in China by forty years of "open ports."

During the last six years there have been built or



Tamarack Copper Mine, Michigan.—Plat on Sixteenth Level, No. 2 Shaft.

depth of 4,600 ft. The hoisting plant installed here will be of a type new to the Lake Superior country. There will be four engines, one at each corner of the great frame. They will be set in an inclined position, cylinders being 32 in. diameter and 56 in. stroke. The drum will be tapered at both ends, running from 16 ft. at end to the straight face of drum, which is 25 ft diameter. It is claimed for this four-cylinder type engine that it will start the load readily and smoothly, and give the highest efficiency.

According to the report for 1897, there was hoisted from the mine a total of 726,665 tons of rock, of which 611,539 tons were stamped. This gave 29,580,380 lbs. of mineral, yielding 20,222,559 lbs. of ingot copper.

equipped for electric traction 12,000 miles of street railroad or tramway in the American Republic. Some part of this vast total is suburban line, lightly and cheaply laid; other parts of it expensive conduit line, as in New York. It would, perhaps, be a fair average to take £5,000 per mile as the average cost of construction and equipment. This gives us the stupendous total of £60,000,000.

If Sir Robert Griffen is right in putting the total export of articles of British produce and manufacture to China at £10,000,000 a year, the American electric traction industry and our China trade stand practically on a level. But whereas the greater part of our China

* London "Invention." * In the "Daily Mail."

trade is in cheap commodities, where skilled labor bears but a small proportion to the total cost, the traction trade requires and develops the highest and most technical artisan skill, and is consequently of enormous social importance. It may be objected that the United States cannot go on making 2,000 miles of tram lines every year, and that the trade must, therefore, prove ephemeral. Even if there were to be no export trade, extensions and renewals in the States alone must continue to employ a vast army of workmen. But there is an export trade.

Whichever country gets the start in the new industry requiring technical skill is bound, other conditions being equal, to keep the start. England got the start in engine making and in cotton manufacture, and to

enables American steel makers to turn out cheaper and better grooved rails.

Curiously enough, there is just one branch of electrical equipment in which England still holds the field—the manufacture of feeder cables.

England got the start in making cables for submarine telegraphy, and she still can make better cables for this and all cognate purposes. Thus even the exception proves the rule; in the handicap of commerce no nation can afford to give any other a long start.

Do not let anyone tell me that Englishmen prefer horse trams. I don't believe that anyone who has ever seen an electric tram prefers a horse tram. The fact is that on a good road paved with wood a horse tram has scarcely any economic justification. The advantage of the horse



Tamarack Copper Mine.—Tramming in a Lower Level.

that start most of her prosperity during this century is due.

America has got the start in electricity, which will be the motive power of the next century. The municipalities and state governments allowed electric tramways to be constructed on easy terms in every American city. American engineers were eager to supply the need. They have developed machine tools, manufactories, skilled labor. To-day they command the markets of the world in all that has to do with electric traction. The equipment for the Waterloo and City and the Central London lines is coming from America. Leeds, in the centre of the locomotive district, had to get its motor cars from America. The first Dublin contract was placed here, but American workmen had to be brought over to complete it. Now the whole electrical equipment for the new extensions has been ordered in America. Cork is even getting American tram rails, for the greater demand

tram over the 'bus is simply in the economy of tractive force produced by running with flanged wheels in a grooved rail. Estimates of the amount saved vary, but the difference is decreasing as roads and wheels improve, and is now comparatively insignificant. It never can be anything like the economy of running on a railway rail, for the dirt and wet which get into the groove must always be a serious set-off against the smoothness of the steel. The horse tram is as noisy as an omnibus, is no speedier, and takes up as much room in the road.

Nor can much be said for the steam trams, of which we still have a few. They are quicker than horses, but they are ugly, dirty, and even dangerous. But with the electric tram it is different. The essential principle of electric traction is that the force is produced not on the street, but in a central power station. Horses, steam engines, oil motors, all take up room and have the other disadvantages which are inevitable if we produce motive

force in retail quantities in the streets. Modern invention has shown us how force can be produced in the factory and distributed to the cars. At the factory are big engines and big dynamos producing electricity on a wholesale scale, the noise and dirt confined to one small area of land away from the public eye.

There are various modes of distribution. There is, firstly, the accumulator system. Under the seats of the car are accumulators, which are charged with electricity at the station. We bottle our electricity, as one may almost say. Londoners are becoming accustomed to accumulators on electric launches and electric cabs. There is no reason except expense why accumulators should not also be used for omnibuses. In Birmingham, Ostend and many other places they are used for tramcars. But the cost is heavy. There is the loss of force, the heavy deadweight to be carried in the cars, and the frequent renewal of accumulators. If the accumulator system were more economical, electricians would not waste their energies in fighting local authorities for tramway concessions. They would put up with the disadvantages from the point of view of tractive force and use the wood pavements without payment, as the omnibus companies do.

The two practicable systems are the conduit and the overhead trolley. In both of these systems the power is conveyed along the line of route by a wire. On the conduit system the wire is carried underground in a concrete conduit and is reached through a slot either in a third rail or in one of the side rails, which must be extra broad. The conduit system involves no greater disfigurement of the road than does a cable tram, and is said to be efficient, but it is expensive, the cost per mile being estimated at as much as £15,000, and necessitates considerable interference with underground pipes, etc., as the concrete bed must be 18 in. to 2 ft. deep. It remains to be seen how far insulation can be obtained on the muddy London streets, and the cost of maintenance must always be considered. The pressure of wood pavement after rain is apt to close the slot, and Londoners would not like to be without their wood pavement. The overhead system is that more generally adopted in the States; it is the cheaper and more efficient.

Committees appointed by the corporations of Leeds, Belfast, Glasgow, Sheffield, Birkenhead, Liverpool, and Manchester have, after inquiry, all reported in favor of the overhead wires. As the Glasgow committee say, the overhead system is that which electricians would erect everywhere if they were allowed. The wire along which the electric current passes may be supported either by span wires crossing the street and fixed to side posts or in narrow streets to the houses, or it may be supported by side brackets projecting from ornamental steel posts some 20 ft. high. If the bracket system be adopted, the same posts can conveniently be used for lighting purposes. If the road be, say, 40 ft. broad, and a double line of tramway has been laid, the posts are best erected in the middle of the street, bearing the trolley wires on projecting arms. Such posts would resemble those used for the electric lighting of Regent street. From the wire the electricity passes to the car through the trolley, a long steel rod, with an ingenious attachment which runs smoothly along the wire.

Whether the conduit or the trolley be adopted, electric street traction has many advantages over any other system of urban transit. These may be shortly summarized as follows:

Economy of Force.—It is well known that with every kind of stage carriage there is a waste of force in restarting after stoppages. It is this which kills our 'bus horses. The electric car takes from the wire whatever force is required, no less and no more. It can thus start easily and run up hill easily. If a number of cars are worked from the same power station, the force used tends

to average itself, and thus there is not the same waste of energy as in other forms of traction. The cost of the force to move a car for one mile can be reduced to less than one half-penny, as against three pence for horse traction.

Cleanliness, Noiselessness, and Saving in Wear and Tear of the Streets.—The cars move silently; there is no possibility of smoke, fumes, or unwholesome excretions. This is only possible because the force is produced in the factory instead of in the streets.

Speed.—It may not be possible to greatly increase speed in the crowded streets of central London, but even there it may be pointed out that it is a gross waste to allow valuable space to be occupied by vehicles which crawl along at the rate of five miles an hour. If the standard rate were ten miles an hour, double the number of passengers could pass along the streets in a given time. In the suburbs there is no reason why the cars should not run twelve miles an hour.

Safety.—The electric car can be pulled up more sharply and is more completely under control than any other vehicle.

Cheapness.—This is partly the result of the cheap production of force and partly the result of increased speed, enabling a larger number of passengers to be carried in the same time with the same number of cars and of men. It is calculated that with electric traction tram fares can be reduced by one-half and the gross receipts increased nevertheless by 40 per cent. The fares need not exceed one penny for three miles in populous districts, a rate which railways cannot attempt.

Why, with all these advantages, has the new invention been neglected in England?

WAVE MOTORS.

For many years inventors have been trying, with more or less success, to harness wave-power to practical use. The plans are based upon two distinct ideas—one being to utilize the progressive impact energy, the other to make use of the alternate rise and fall of the waves. A report of a promising and interesting venture comes from Los Angeles, Cal., where a small plant has been run out a few rods into the sea and some motors invented by a Mr. Porrin Wright have been installed for experimental purposes. Floats are arranged so that as they rise and fall they move the plunger of a pump. Fresh water, taken from a tank, is forced into an air reservoir, which resembles in principle, if not in form, the air chamber of a steam fire-engine or a hydraulic ram. The air being compressed causes the water to issue in a steady stream through a nozzle, and the latter is directed against the buckets of a wheel of the Pelton type. The power developed was used only in an experimental way, but it is proposed to build a transmission line four miles long to supply light and power at Redondo. The description of this plant was given in the New York "Tribune" of April 17th, 1898, with the following comment: "Any system of developing power which, like the windmill or sunshine, is intermittent, is not very serviceable, unless accompanied with suitable means for storing power. And unless a wave motor is operated where there are waves every day, it, too, will require such a supplement. In the winter season, one may readily believe, there would be enough of a swell on certain coasts to keep a Wright motor running continuously. In the summer time, on the other hand, there is danger of interruption for days at a time. If it be found practicable to dispense with storage systems during the next six months as thoroughly as has been possible for the last six, an important industrial triumph will have been achieved. But if it prove necessary to fall back on enormous water tanks or electric accumulators, or to introduce a steam plant, to insure continuity of business on days when the sea is unruffled, the economy of the plan will be diminished, perhaps to the zero plant."—Ex.

ELECTRIC TRACTION.

NOTES ON THE APPLICATION OF ELECTRIC MOTIVE POWER TO RAILWAY SERVICE, WITH ILLUSTRATIONS FROM THE PRACTICE OF THE METROPOLITAN ELEVATED ROAD OF CHICAGO.

BY M. H. GERRY, JR.

(Continued from page 22.)

The energy to overcome train resistance for the same distance is equal to 1,045,000 foot pounds. Summed up, the energy would be as follows :

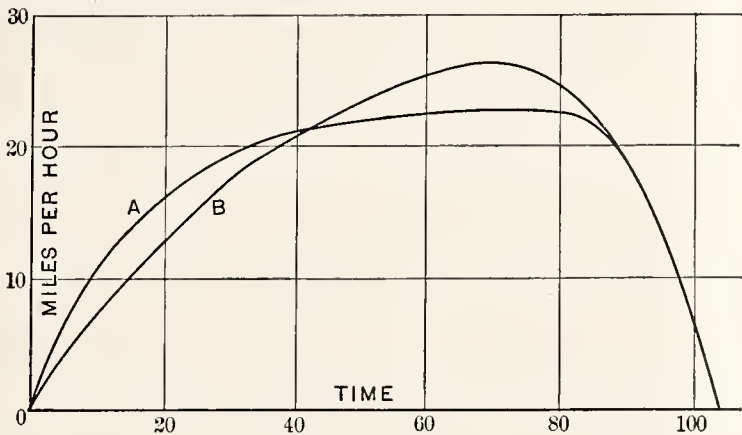


Fig. 5.

For accelerating the train, - 3,800,000 foot pounds.
For the grade, - - - 1,900,000 " "
For train resistance, - - 1,045,000 " "

Total energy required, - 6,745,000

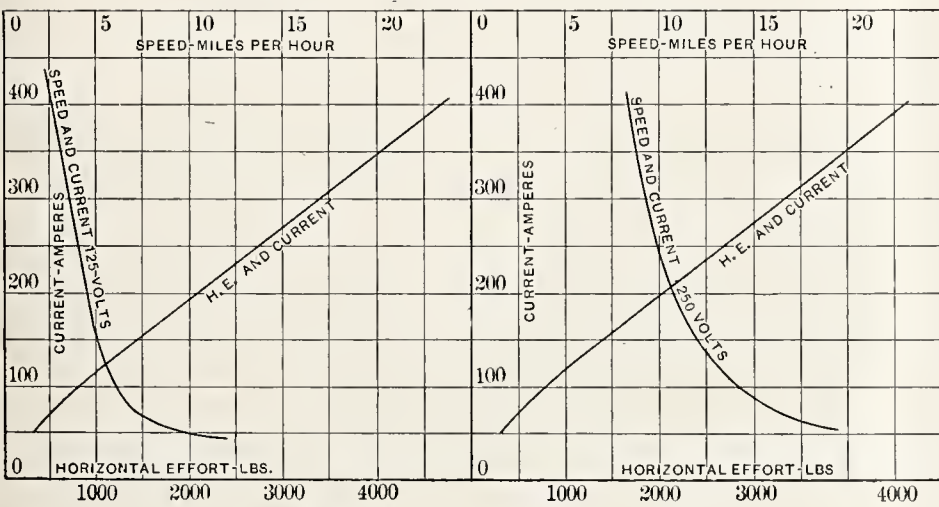


Fig. 8.

Fig. 7.

This represents the total energy that must be supplied to the train from the time of starting, up to the moment the brakes are applied. From this point the acceleration is negative, and the kinetic energy of the train is absorbed by train resistance, the grade and the brakes. The amount taken up by the brakes is 2,900,000 foot pounds.

The above case is for the train on a 0.5 per cent. ascending grade. For the train on a level the figures would be as follows :

For accelerating train, - 2,800,000 foot pounds.
For train resistance, - 1,045,000 " "

Total energy required, 4,845,000

The amount absorbed by the brakes in this case will be 3,500,000 foot pounds.

For the same train and speed conditions for a 0.5 per cent. descending grade, the figures are,

For accelerating the train, - 3,800,000 foot pounds.
For train resistance, - 1,045,000 " "

Total energy required, - 4,845,000
Supplied by descending grade, 1,900,000

Total external energy required, 2,945,000

The total energy absorbed by the brakes in stopping the train in this case is equal to 4,100,000 pounds.

The foot pounds per ton mile in each of the cases cited are as follows :

On an ascending grade, - 142,000 foot pounds.
On a level, - - - 102,000 " "
On descending grade, - 62,000 " "

The average speed taken from the curves in the cases cited is 16.5 miles per hour, not including stops. Allowing twelve seconds for a stop, it is fifteen miles per hour.

The average rate of using energy or the power, allowing time for stops, is as follows :

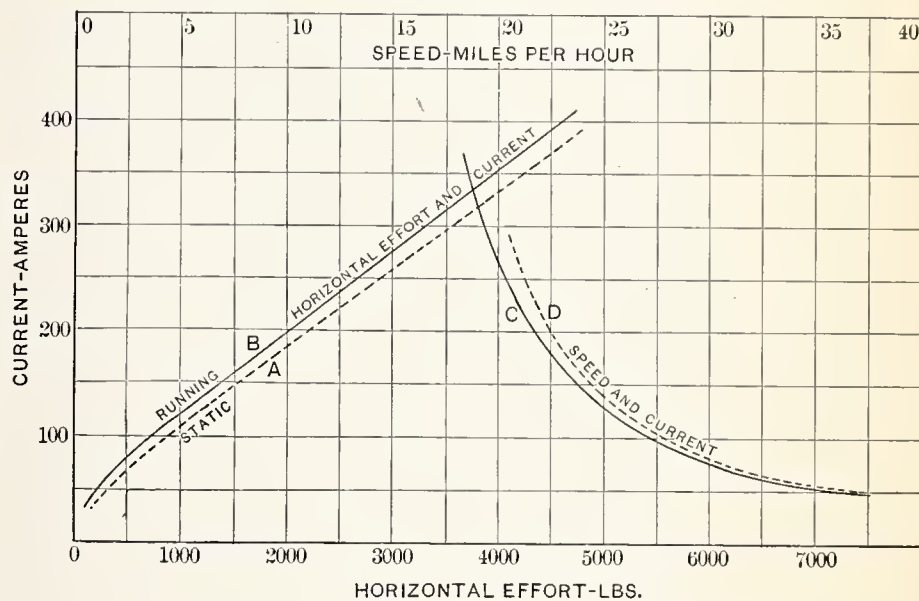


Fig. 6.

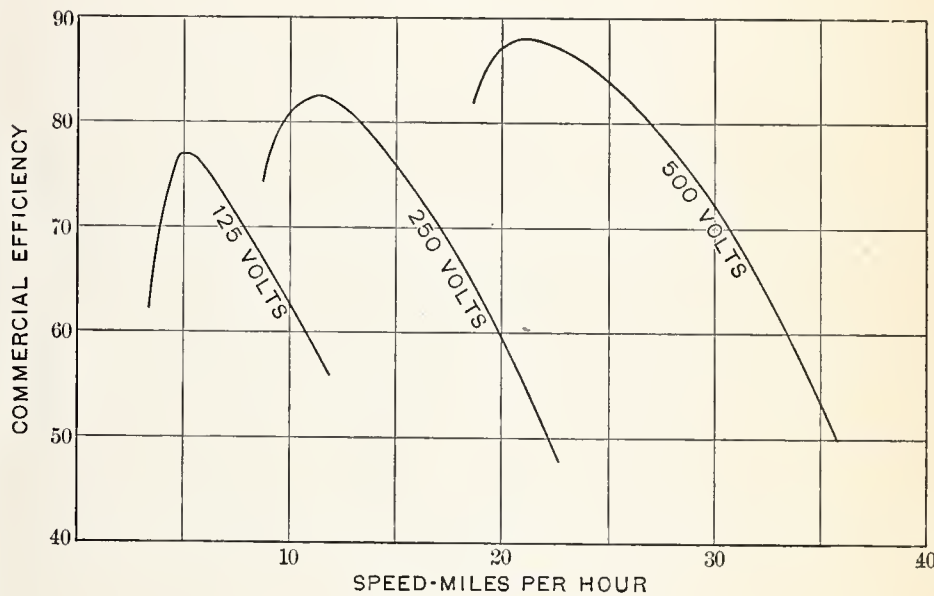


Fig. 9.

On a 5 per cent. ascending grade, - 106.5 H.P.
On a level, - - - 76.5 "
On a 5 per cent. descending grade, - 46.5 "

The power may also be divided as follows:

For accelerating the train, - - - 60 H.P.
For ascending grade, - - - 30 "
For train resistance, - - - 16.5 "

These figures do not, of course, include losses in applying the power, and only represent the energy which must be applied at the rails to produce the results in the special cases named above. The conditions vary widely at times on the same road, but the above examples may serve to show how great is the percentage of power required to accelerate the trains when the stops are frequent.

In a speed curve with a time base, such as Fig. 3, the area enclosed is proportional to the distance travelled. That part of the area enclosed by the curve from B to C, a perpendicular from the point C, and the base line, depends on the form of the braking curve and hence on the efficiency of the brakes. The area enclosed by the curve from A to C, the perpendicular and the base line, depends

on the form of the accelerating curve. The distance between stations being fixed, the area enclosed must be constant and independent of the form of the curves. The shape of the curve may be altered, however, in two general ways, first by changing its form so as to still enclose the same area, with the same length of base, and secondly, by altering the form of the curve and changing the length of the base. This latter change will alter the time between stations, while either of the changes may or may not affect the amount of power used, this depending principally on the maximum speed attained. In Fig. 5, the curves A and B represent equal distances passed over in equal times, but the energy required for curve A is materially less than for curve B. The amount of power required in any case will depend largely upon the form of the speed curve, that is, upon the rates of accelerating and retarding of the train, and it is always desirable to keep the maximum speed as low as possible.

The Motors and Controlling Apparatus.

At the present time, direct current series motors with series-parallel controllers are in all but universal use for electric railways. Shunt motors are in service in Europe to a limited extent, and alternating current motors have been given a trial. The latter have advantages under certain conditions for lines of considerable length where there are but few stops. Alternating current motors tend to run at a nearly constant speed, approaching synchronism, and do not regulate with the same facility and efficiency as direct current motors. They develop, however, a good starting torque and may even produce a better form of torque-speed curve than the common series motors. The double conductor required with alternating current motors is an objection, but there are many advantages in their favor; the system is untried and its possibilities are not fully known.

The characteristics of the motors in use on the Metro-

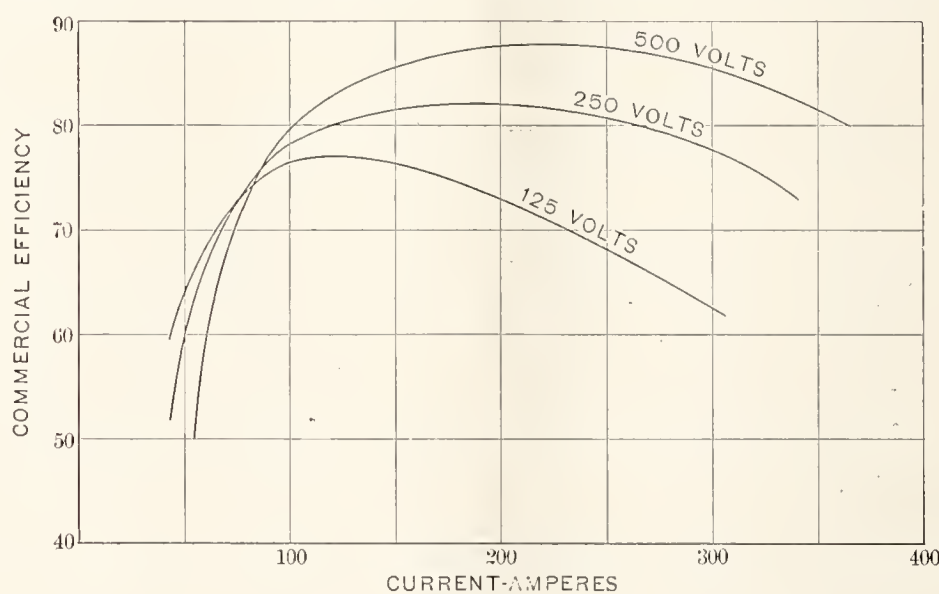


Fig 10.

Motors efficient at high speed are sometimes wasteful of energy because of insufficient torque, at starting and at low speeds, to produce a good form of acceleration curve.

The train weight may be considered as made up of two parts, the live, or paying load, and the dead load, which includes the weight of rolling stock, motors, etc. As the amount of power required by the train varies almost directly as the weight, it is desirable to have the non-paying or dead load as small as possible. In order that there may be sufficient traction, a separate locomotive must weigh between four and five times the maximum drawbar pull required by the train, all of which is dead load, in addition to that of the cars. It has been stated that a rapid acceleration is desirable if there are many stops, but as each pound of increased maximum drawbar pull from a locomotive must add four or five pounds to the dead weight of the train, a point is soon reached where no further advantage is obtained by increasing weight on drivers and drawbar pull. The weight admissible on the locomotive driving wheels, on account of track and structure, also limits the amount of traction, hence the drawbar pull and rate of train acceleration. Thus, for a service combining high speed and many stops, there are advantages in a form of motor which may be so placed as to utilize a part of the car weight and live load, for purposes of traction. The cars should weigh as little as possible, so as to reduce the total dead weight of the train, for it is well known that the ton-miles of paying load form only a small percentage of the total ton-miles moved. On elevated roads it is probably below six per cent. on the average, and on some roads below one per cent.

It is hoped that these remarks may direct attention to the question of economy in the use of power or to what may be called train efficiency, in contradistinction from the efficiency of the apparatus used in the generation and transmission of the power to the car axles. This latter subject will now be considered.

politan Elevated are introduced in this paper rather than a general discussion, and it is hoped that this will be acceptable. By modifying the design the relations existing between the torque, speed, current and voltage may be varied within wide limits, but the general relations are always the same and are well illustrated by the diagrams below. All modern railway motors are much alike, the designers having been forced by the conditions imposed upon them into practically one general type of machine. The requirements are a large output, ability to withstand heavy overloads, freedom from sparking, a low rotative speed, light weight and limited space. The result is the cast-steel multipolar motor, operating with nearly saturated fields and high magnetic densities in the armature.

In electric motors the relations between speed, horizontal effort (or torque), current, voltage, and efficiency are all fixed, and may be readily determined for any particular motor. For most practical purposes it is best to represent these relations graphically. At A, in Fig. 6, the relation between current flowing and the static horizontal effort produced, is shown for the standard motors in use on Metropolitan Elevated Road. Curve B, in the same figure, represents the horizontal effort produced when the motor is running with 500 volts at the terminals and at the speeds shown by C. The horizontal distance between A and B represents the loss in horizontal effort due to friction and core losses. Curve D, in the same figure, gives the speeds which the motor would attain under the conditions named if there were no internal resistance, and the horizontal distance between the latter curve and C represents the loss in speed due to such resistance. Thus the losses in a series motor may be divided into two classes, those that lessen the torque and those that reduce the speed. In Figs. 7 and 8 the relations between current, speed, and horizontal effort are plotted for the same motor at 250 and 125 volts. The static horizontal effort is the same in all cases, but the running horizontal effort is slightly greater for the same current

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ELECTRICAL PROGRESS IN MONTREAL.

The large cities of the United States have been receiving so much attention the last few years on account of the rapid growth of electrical industries within their confines that other sister cities in a land that is one with us in its love of liberty and high ambitions have been forgotten. The Canadian Electrical Association, the programme of whose proceedings was published several weeks ago in our columns, attended their annual banquet at Montreal not quite two weeks ago. The mayor of Montreal delivered a toast entitled, "Electrical Montreal and the City of Montreal," which showed an intimate acquaintance with the development of electric light and power concerns in that city. The statistics he gave were as follows:

The Royal Electric Company began in 1884 with a dynamo of twelve arc light capacity, a dozen employees, a small workshop, and a capital of less than \$50,000.00. Today it has a manufactory covering an area of about 40,000 square feet. The total employees of the company in its manufacturing business is upwards of 5,000; its capital investment upwards of \$2,500,000.00. The mayor further stated in substance that Montreal was first illuminated in 1886 by electric light, only 113 being in use at that time. At present there are more than ten-fold as many, at least 1,500 representing the total. The mayor spoke of the transmission plant being erected by the Chambley Manufacturing Company, whose intention it is to send 20,000 H. P. into the heart of Montreal for distribution as required. The Lachine Hydraulic & Land Company's enterprise, representing an investment of \$2,500,000.00, whose object is the harnessing of the St. Lawrence River for the benefit and betterment of Montreal.

The street railway plants of Montreal were referred to, and the mayor stated that in August, 1892, two dynamos, whose combined capacity equalled but 500 H. P., represented all that was being done in the line of electric

traction. At the present time 10,000 H. P. is being generated; miles upon miles of track are in use. The development in other directions, including the telephone, has become something enormous, Montreal bidding fair to rival in the extent and significance of such improvements the greatest cities in the United States. It is gratifying to realize that the signs of greatest progress are visible only on this side of the Atlantic. Our European friends can see year by year tremendous advances, which include every imaginable department and every application of electricity. The heaviest electrical machinery is now being shipped to England herself, at one time the greatest source of manufactured articles in the world, but today beginning to be dependent upon America for many of the things she originated and made herself.

The transplantation of commercial centres from the old world to the new became inevitable when the natural resources of this country were fully appreciated. The tide of improvement has kept pace with civilization, and moved westward with resistless force. The commercial activity in this country is not one iota of what it will be a century hence, Canada included, and we feel safe in prophesying that of the millions upon millions of dollars circulating from centre to centre a large percentage will be devoted to electrical manufacturing.

The development of a useful science cannot be anticipated because of the mysteries that lie hidden beyond. Inventions that may yet thrill the nations are inchoate and unthought of. Ideas which, when crystallized, will give employment to thousands of men are still unborn, but the life-blood of trade circulating and pulsing through this great nation is building up new and healthy tissue, giving body and form to this country of surpassing magnificence.

THE NATURE OF CONDUCTION.

The constant vibration of all matter is merely a proof of the continuity of the great chain of force extending through the universe. The phenomena of conduction is certainly a vibratory action of a systematic nature controlled by a form of energy in itself but superficially understood, yet which gives rise to secondary effects most familiar to our senses. Heat and ultimately light appear in response to its influence, showing, as it were, that a moving current induces changes in conducting bodies which could have been created by the direct application of friction, transmitted heat or by chemical action. The conduction of heat, in many respects, is analogous to the conduction of electricity. It differs from it in its slowness of transmission and immense loss by radiation.

The nature of electric conduction will never be known until a thorough analysis is made of those peculiar forms of vibration which constitute heat, electricity and light. The interaction of a material particle, so called, upon the ether is so little within our true sense of appreciation that theories, explanations and abstract conclusions of any description are useless.

A study of molecular physics, a knowledge of the mechanics of heat and a review of all great works touching upon the ultimate effect of force upon matter will prepare the mind for a careful consideration of the cause of conduction and possibly lead us to anticipate the inherent nature of this remarkable phenomenon.

London, Ont.—Application will be made to the Parliament for an act to incorporate a company to construct an electric railway from this city to a point near Grand Bendon, Lake Huron.

Rimouski, Que.—A company has been formed to construct a telephone line from this place to Matane and work will commence in the spring. The promoters are J. Elzear, G. Martin and others.

at the lower voltages, because the losses which affect it are less at the lower speed. At the same time the percentage of loss due to internal resistance becomes greater, as it depends upon the current flowing, while the total input of energy varies with the electrical pressure as well; hence, the reduced efficiency at the lower voltages. Curves of efficiency, in relation to the current, are plotted in Fig. 9 for the same voltages.

In Fig. 10 the efficiency is plotted to the speed, and it will be seen that the curves fall off rapidly above or below a certain narrow range of speed over which the efficiency is high, at any one voltage. There is a considerable range of current and horizontal effort over which the efficiency is high, as can be seen from Fig. 9, but it corresponds to only a small speed variation. The relations of speed to horizontal effort are given in Fig. 11. The maximum working range of the motor is from 350 to 4,000 pounds horizontal effort, and the total speed variation on this range at 500 volts will be about 14 miles, and at 250 volts about 10 miles. The range of speed obtained in service at any one voltage is practically about one-half this amount, and if 250 and 500 volts be considered as the pressures at the motor, in series and parallel combina-

fixed by the permissible increase in temperature. The amount of such increase will depend on the average load, the efficiency of the motor and the extent and character of the heat radiating surfaces. The actual load on a railway motor differs, at times, very widely from the average load, and ability to withstand these fluctuations will depend in part on the heat storage capacity of the motor. The metal acts to a considerable extent as a reservoir of heat, receiving it when the motor is doing its heaviest work and giving it up at lighter loads. A glance at the load diagrams in the latter part of this paper will serve to show how great these fluctuations may be under certain conditions. The amount of heat radiated in a given time varies greatly with the speed of the car and the temperatures. With the air at 60° F., and under average working conditions, a Metropolitan motor will radiate heat at the rate of about 650 British heat units per minute. This is equal to 15 horse power, corresponding about to 60 horse power of loading. But these motors will readily withstand for a considerable period of time a loading of three times this amount. Most of the heat produced by this additional loading must be stored in the metal of the armature and frame. A considerable

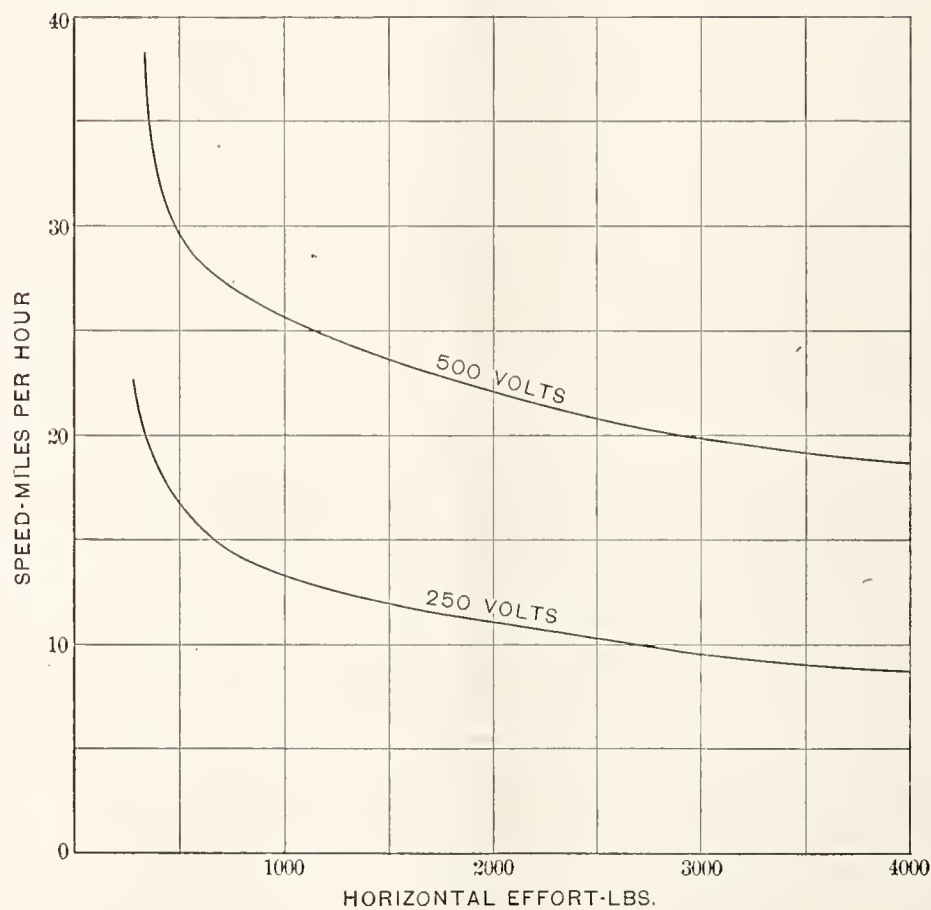


Fig. 11.

tion, then the total range of speed, without further alteration of the voltage by resistance in circuit, will be about 12 miles over a total speed range of 34 miles. For each combination of motors in series parallel, there is a certain range of speed over which the efficiency is equal to that of the motors; but at all other speeds resistance must be introduced in circuit, and the efficiency is reduced.

The weight of the armature and other revolving parts is a feature of importance in motors designed for a high-speed service requiring frequent stops. These parts should be as light and the rotative speed as low as possible. The armatures of the Metropolitan motors weigh approximately 1,400 pounds and are 18½ inches in diameter. At 800 revolutions per minute, corresponding to 25 miles per hour, the kinetic energy in each armature is equal to 43,000 foot pounds. Thus, for a two-motor equipment, 86,000 foot pounds of energy are dissipated each time the car is stopped from a speed of 25 miles per hour. This amount of energy will vary with the square of the maximum speed, and, if stops are frequent, it becomes an appreciable loss.

The average load a motor is capable of sustaining is

part of the heat is generated in the armature, but its thermal capacity being nearly 150 heat units per degree, a large amount of heat energy can be stored before the temperature reaches the danger point. Slow speed armatures in general have more metal in them, and are thus better able to stand a variable load.

(To be continued.)

SOME PHASES OF THE RAPID TRANSIT PROBLEM.*

BY ALBERT H. ARMSTRONG.

The rapid transit problem, in congested districts, has to deal with the transportation of passengers at a high average speed with frequent stops, and even in suburban traffic where the stops are less frequent the schedule speeds have been so increased by the ability of the electric motor to accelerate rapidly, that trains hardly reach full speed before it is necessary to apply the brakes. As running at a constant speed does not occur in rapid

* Paper read before the American Institute of Electrical Engineers, Omaha, June 28, 1898.

transit service where stops are at all frequent, it becomes of the greatest importance to carefully investigate the subject of train acceleration in order to determine the method of running a train from station to station with the least expenditure of energy.

Problems in train acceleration may be divided into two broad classes: 1. Where the road is level, and

2. Where grades exist or where an artificial profile is made in order to take advantage of down grades at starting.

Modern passenger cars demand a dead weight of approximately 550 lbs for each passenger carried, or, in other words, only 20 per cent. of the total weight of a loaded motor car is a paying load. When it is considered

Tractive effort, 100 lbs. per ton total, to be maintained uniform during acceleration of the train.

Braking effort, 150 lbs. per ton constant throughout the period of braking.

The train friction being 15 lbs. per ton, reduces the effective accelerating force from 100 to 85 lbs. per ton, corresponding to a rate of .927 miles per hour per second.

With this data a simple acceleration curve, as in Fig. 1, may be calculated, the train reaching a maximum speed of 28 miles per hour in 30 seconds, when power is shut off and the train allowed to coast with a retardation due to friction of .1635 miles per hour per second for 31 seconds to the braking line, when it is retarded at a uniform rate of 1.625 miles per hour per second and comes

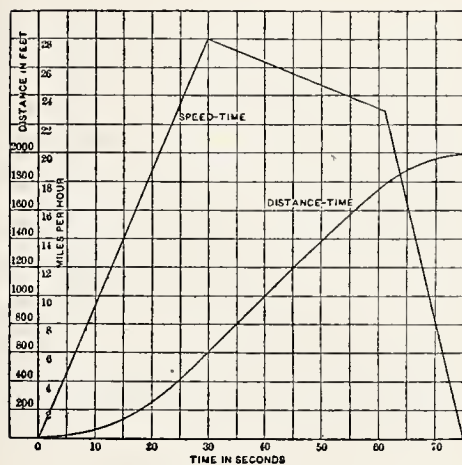


FIG. 1.—ACCELERATION CURVE

Distance, 20.0 ft. Time, 75 secs. Tractive effort, 100 lbs. per ton. Friction, 15 lbs. per ton. Braking effort, 150 lbs per ton

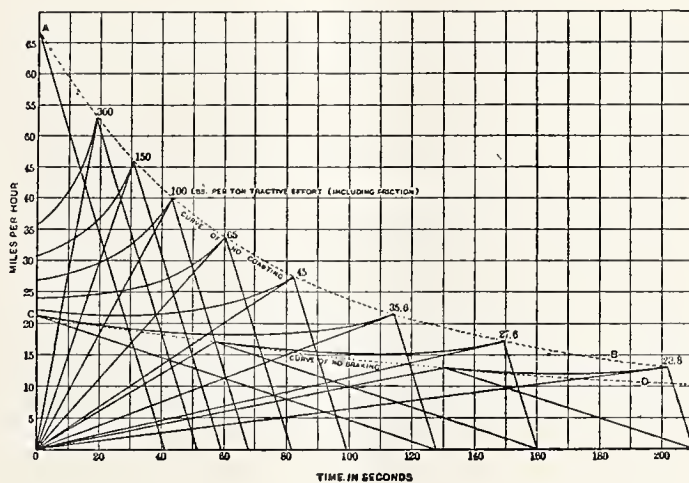


FIG. 3

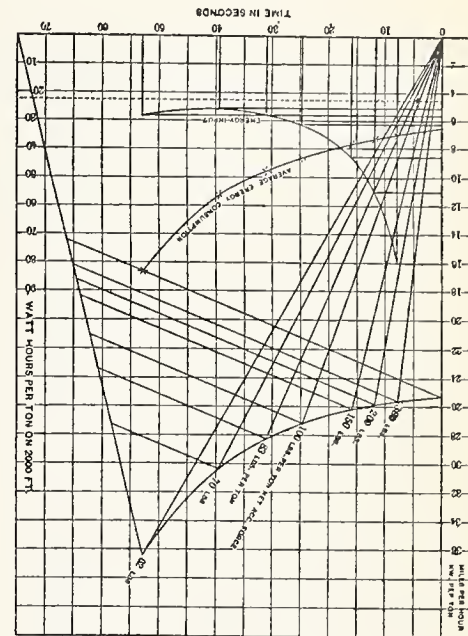


FIG. 2.—SPEED AND ENERGY CURVES

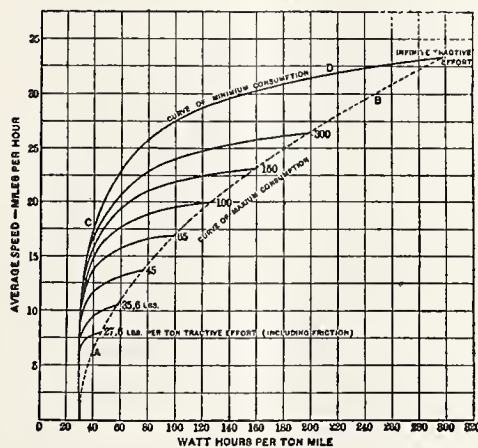


FIG. 4.—SPEED-ENERGY CURVES

Distance, 2000 ft. Time, 75 seconds. Starting grade of 4 per cent. Tractive effort of motor, 100 lbs. per ton. Friction 15 lbs. per ton. Braking effort, 150 lbs. per ton.

that in rapid transit service with frequent stops, over 80 per cent. of the total energy output of the motive power on level roads is required to accelerate the train, it is evident that in this class of service the rolling stock requires the greatest attention.

To avoid undue complication, the following discussion has assumed that train friction is a constant quantity at all speeds, as at the low maximum speeds—20 to 30 miles per hour—reached in practice with frequent stops of two or more per mile, the error introduced by assuming a constant friction rate will be small and will not at all alter the conclusions arrived at.

The following constants have been assumed as representing average operating conditions:

Length of run, 2000 ft.

Length of time train is in motion, 75 seconds.

Schedule speed, 16.05 miles per hour, including 10-second stops, or 85 seconds total time.

to rest in 75 seconds from time of starting.

Owing to the greater efficiency of the run, the train is allowed to coast after reaching its maximum speed rather than to allow it to continue at a uniform speed with just sufficient power supplied to overcome the train friction loss.

It is obvious that the train could be accelerated at a different rate than that corresponding to 70 lbs. per ton and still make the same length of run in the same time, the length of time occupied in coasting depending upon the rate of acceleration, being a maximum with an infinite rate, that is, with the train starting with a certain initial velocity. A minimum rate of acceleration is reached when no time is left for coasting, that is, when brakes are applied as soon as power is shut off.

In Fig. 2 such a set of curves has been prepared, showing a train covering a distance of 2,000 ft. in 75 seconds, as before, but accelerating at various rates from that

corresponding to 62.8 lbs. per ton as a maximum up to an infinite rate, or starting with an initial velocity of 25.2 miles per hour.

As the area inclosed by time as abscissæ and speed as ordinates represents the distance covered, this will be a constant quantity for the fixed distance of 2,000 ft. assumed, and curves of Fig. 2 are thus constructed with the same inclosed area for each rate of acceleration. The fact is plainly brought out that with a low rate of acceleration a much higher maximum speed is demanded than would be the case if the rate had been increased, and a curve may be plotted by joining the maximum speeds reached for different accelerating rates, as shown.

A friction of 15 lbs. per ton has been chosen as being that of an average train composed of a motor car and three or four trailers and weighing about 120 tons. With heavier and longer trains this rate may be reduced to as low as seven or eight pounds per ton, while for a motor car alone, the rate may be as low as 30 lbs. per ton, due to friction of motors and gearing. The braking effort of 150 lbs. per ton is also chosen as representing what can be done on an average by a train equipped with air brakes and operating at half the slipping coefficient of the wheels.

It is advisable in rapid transit service to keep the maximum speed reached by the trains as low as possible, as this class of work generally calls for a short time-interval between trains where the utmost precautions are necessary to keep the trains a safe distance apart. In fact, the maximum speed required for a given run practically determines the time-interval between trains, as the train headway should be at least five or six times the length of time required to bring a train to rest from its maximum speed with normal braking force applied.

A second reason for higher rates of acceleration lies in the fact that with rates of acceleration approaching the minimum no margin is left for errors of judgment of the motorman, as little or no time is left for coasting, and the rate of acceleration per amp. input is continually varying with the changing passenger load, and hence with an overload it becomes difficult to maintain schedule speed.

A third and most important objection to the use of a low rate of acceleration lies in the saving of energy for the run by the use of a higher rate.

Neglecting $I^2 R$ and core losses of the motors, a set of energy input curves per ton weight of train may be plotted as in Fig. 2, assuming for simplicity that motors are series wound, operate all in multiple and are so geared that starting resistance is entirely cut out at the various maximum speeds reached in the various runs, that is, that no acceleration is done on the motor curve. A constant impressed e. m. f. is assumed, and starting resistance is supposed to be cut out proportional to the motor speed, thereby keeping the current and torque constant.

Thus it is seen that accelerating a train with the minimum rate calls for the highest maximum speed, demands nearly the least current input and also demands the greatest waste of energy in the brakes, as the speed is a maximum when brakes are applied.

The areas inclosed by the various energy time curves represent the comparative amounts of energy required for the run for the different rates of acceleration and these are plotted in Fig. 2, which compares the energy input and the average energy consumption for the run of 2,000 feet in 75 seconds for all rates of acceleration from the minimum corresponding to 62.8 lbs. per ton up to infinity.

For convenience the average energy rates are plotted in terms of watt hours, and the curve shows that while the minimum rate of acceleration corresponding to 62.8 lbs. per ton calls for an expenditure of 83.5 watt hours per ton weight of train, this is reduced to 56.5 watt hours by accelerating with a rate corresponding to 70 lbs. per ton, to 42.7 watt hours with 100 lbs., and finally reaches

a minimum value of 32.5 watt hours if the accelerating rate is pushed to infinity.

Thus the energy required for the run of 2,000 ft. in 75 seconds may vary from 83.5 to 32.5 watt hours per ton of train weight, a decrease of over 60 per cent., depending upon the rate of acceleration used.

The curves in Fig. 2 are worthy of careful study, and similar curves afford a means of determining the proper rate of acceleration and hence motor equipment, gearing, etc., to use for a given set of conditions. The limiting factor in the more rapid rate of acceleration of a train is the current input required. Thus, if the rate of acceleration be carried to abnormally high values, the local demand for current becomes so great that either the loss in the feeders more than offsets the reduction in energy consumption at the train, or else the interest on the increased feeder investment is not offset by this energy reduction.

There are other limiting factors governing the rate of acceleration in the size and weight of motors, which are limited in the current they can carry without undue sparking and heating. Thus it will be found that the rate at which a train accelerates largely determines the cost of feeders, size of motors and generators, both in regard to current and thermal capacity, and also fixes the safe headway between trains.

The error made in accelerating at or near the minimum rate is clearly brought out. For example, the current consumption per ton is the same for 62.8 lbs. per ton or 85 lbs. per ton; as, although 85 lbs. calls for the greater tractive effort, the torque per amp. is so increased by the lesser maximum speed demanded that the current input is the same in each case; hence the feeder considerations are the same in both cases, while the energy consumption shows a reduction from 83.5 watt hours per ton, with 62.8 lbs. to 47.5 watt hours, or about half, with 85 lbs. per ton.

Referring again to Fig. 2, it is obvious that a similar set of curves may be plotted for a run of 2,000 feet for any other length of time than 75 seconds, and Fig. 3 gives such a set of curves plotted for lengths of time ranging from 41 seconds, as a minimum possible, up to 210 seconds. The minimum time in which it is possible to make a run of given length is determined by the braking effort, in this case assumed to be 150 lbs. per ton, the train reaching a maximum speed of 66.5 miles per hour in zero seconds, with an infinite accelerating force, and being retarded throughout the entire running time of 41 seconds at the rate of 1.635 miles per hour per second, corresponding to a force of 150 lbs. per ton braking effort.

The constants assumed in these curves are the same as before, 15 lbs. per ton friction rate, and 150 lbs. per ton braking effort applied uniformly until the train comes to rest at a distance of 2,000 feet from the start. While the braking effort determines the minimum length of time for the run, the friction rate imposes a limit upon the maximum rate of acceleration possible for lengths of time greater than 128 seconds for 2,000-foot run. That is, a train accelerating with an infinite rate and coasting the entire length of 2,000 feet, would come to rest in 128 seconds with no energy loss in the brakes, and any longer interval of time occupied in the run would require some finite rate of acceleration at a maximum. This is pointed out in Fig. 3, where for a run in 210 seconds the maximum rate of acceleration possible is .175 miles per hour per second, corresponding to 24 lbs. per ton. No train in practice would require such a long time as 210 seconds, nor would it be possible to make a run of 2,000 feet in 41 seconds, but these curves have been carried out to show the limits for a given set of conditions.

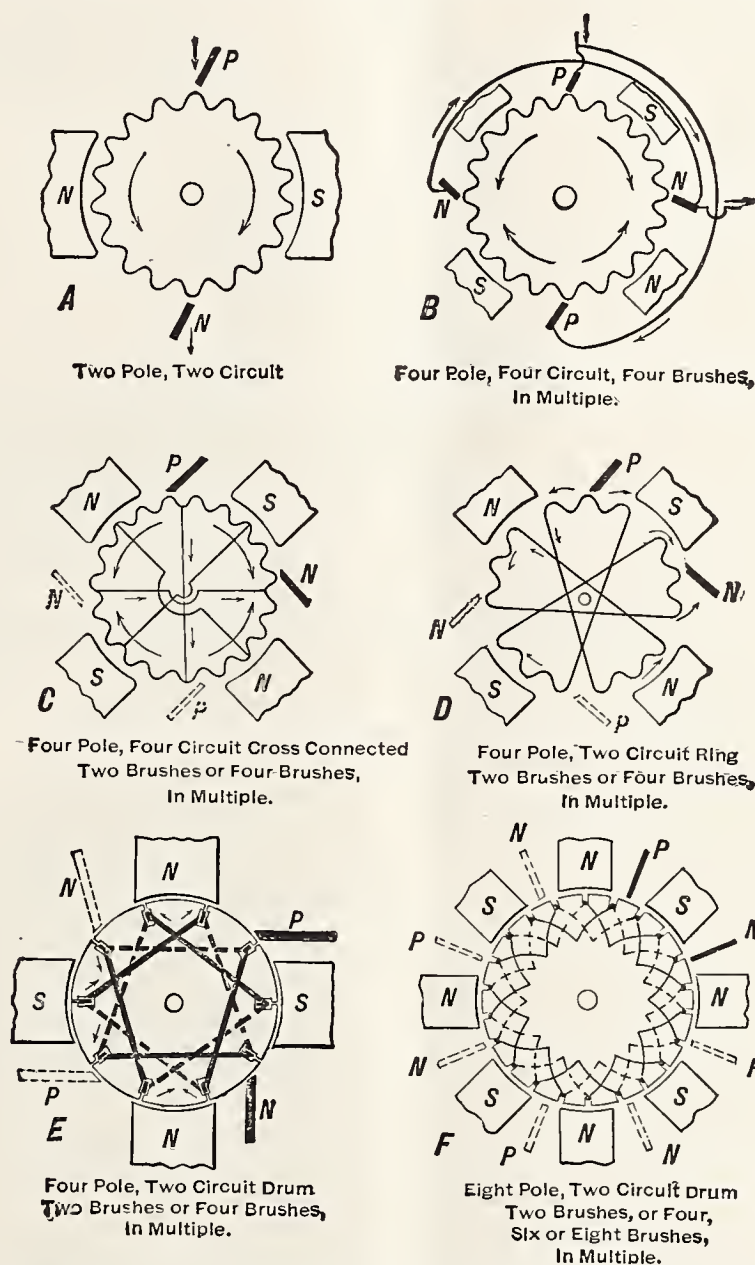
As the energy lost in braking is proportional to the square of the speed when the brakes are applied, the curve A—B, Fig. 3, being the locus of the minimum rates of ac-

celeration, that is, with no coasting, is thus the curve of maximum input for a run of 2,000 feet for any length of time. Also the curve C—D, being the locus of the various coasting lines, that is, of no braking effort, is thus the curve representing the minimum possible input.

To compare the amounts of energy required for rates of acceleration other than the maximum and minimum, a set of curves has been prepared in Fig. 4, giving the energy consumption for a run of 2,000 feet on a level track for any rate of acceleration and for any length of running time, the constants being 15 lbs. per ton friction rate and 150 lbs. per ton braking effort. For convenience in comparison, the energy consumption is reduced to watt hours per ton mile, and speed is expressed as average speed in miles per hour while train is in motion or equaling schedule speed if train loses no time in stopping. The dotted curve A—B is the maximum energy curve corresponding to the curve A—B of mini-

and distance traveled. For example, a train accelerating with a tractive effort of 100 lbs. per ton and making 20 miles per hour average speed, not including stops, will require 127 watt hours per ton mile, which would be reduced to 65 watt hours per ton mile if the tractive effort had been increased to 150 lbs. per ton, or, in other words, the generator capacity would be but half as large for the same service.

The curve of 300 lbs. per ton tractive effort is interesting, as it represents about the maximum speed attainable with modern apparatus for a distance of 2,000 feet with the assumed constants of friction and braking effort. Assuming the entire weight of the car to rest upon drivers, about 300 lbs. per ton would be available for traction without slipping the wheels on an average track, so that an average speed of $26\frac{1}{2}$ miles per hour is the highest that could be obtained over a distance of 2,000 feet, not allowing any time whatever for coasting.



Principles of the Connections in the Different Types of Armatures.

imum rates of acceleration in Fig. 3, and the curve C—D represents the minimum amount of energy possible for the different speeds and is described by an infinite rate of acceleration. The curves of maximum and minimum energy consumption approach each other and coincide at a speed of 33.3 miles per hour, corresponding to an energy consumption of 298 watt hours per ton mile, this value being the greatest amount of energy that can be expended on the run with 150 lbs. per ton braking effort.

All energy values are net; that is, they represent the amount of energy required to accelerate the train plus energy lost in overcoming friction, and hence take no account of any losses occurring in actual operation in the motors, rheostats, gearing, etc.

Fig. 4 shows the economy resulting from properly proportioning the accelerating rate to the schedule speed

All previous curves have been based upon the assumption that trains are allowed to coast after reaching maximum speed, and also that acceleration is carried on at a perfectly uniform rate until power is shut off, but in practice this assumption may be modified somewhat, the starting resistance being cut out before the maximum speed is reached, and the latter part of the acceleration carried on at a constantly decreasing rate upon the motor curve.

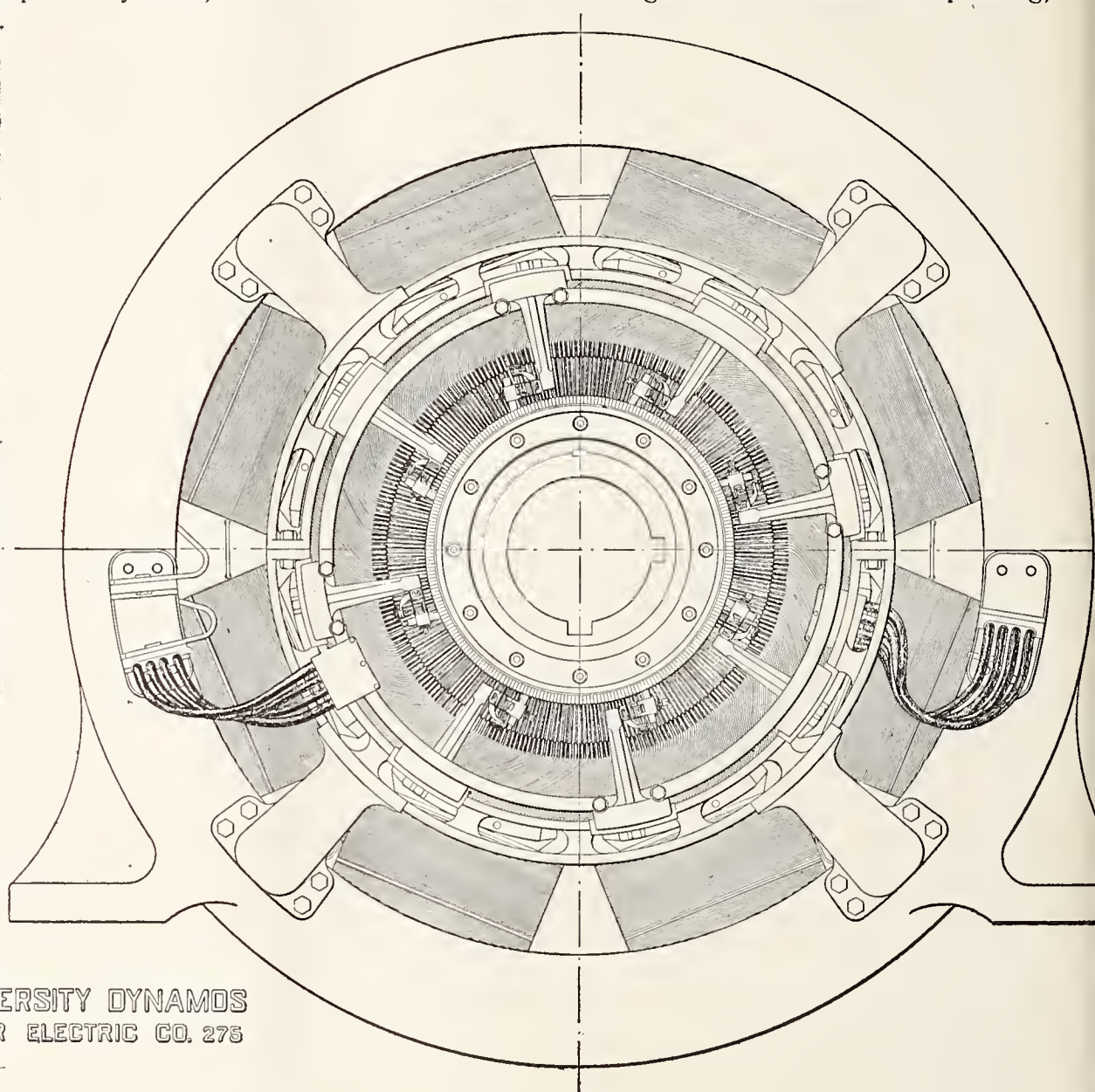
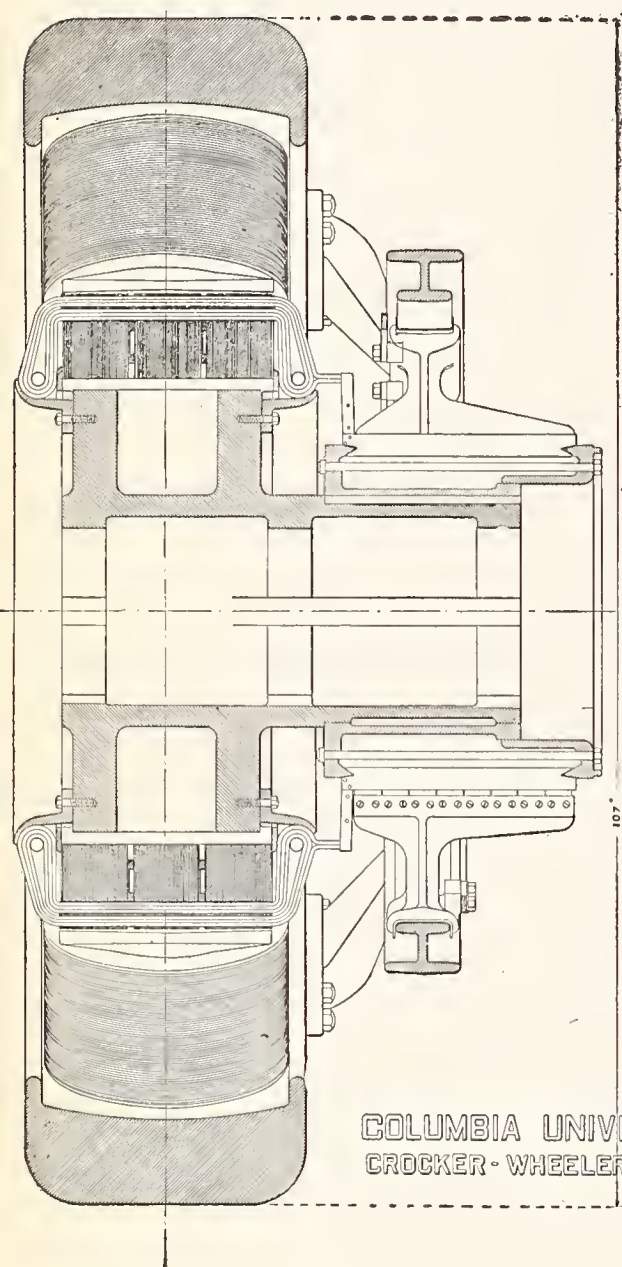
(To Be Continued.)

THE DESIGN AND CONSTRUCTION OF DYNAMO-ELECTRIC MACHINES.

Columbia University is illuminated at night by large generators, the design and construction of which is the

work of two of its graduates, Messrs. Crocker and Wheeler, of the well-known company bearing that name. The general details of construction are shown in the accompanying sketches. The multipolar dynamo within the last ten years has gradually usurped the place once occupied by great two-pole machines. Originally a prejudice existed against the multipolar dynamo, and

in one, having a common armature and commutator. The combinations that can be made with the armature winding are very numerous, the standard text books containing a great variety of illustrations bearing upon the subject. The weight and output of a given amount of material have been almost doubled since the use of mild steel for frames is in vogue. The causes of sparking,



Front and Side Elevation Drawing.

various technical objections were brought forward against its use. But they have long since vanished, and the most satisfactory and most economical piece of machinery we have is the multipolar generator.

The connections of the armature of a multipolar generator are simple enough when represented in the manner shown. Generally speaking, there are two classes of windings, wave and lap, each of which may be used in the armature of a multipolar machine or a combination of them. The ordinary bipolar dynamo using two brushes possesses two circuits in its armature, as shown in the upper left-hand sketch. The simple form of multipolar winding of the same description simply doubles the number of circuits, necessitating the use of four brushes, as shown in the upper right-hand corner. The armature winding in this case is called lap winding. The four cases below are those of wave winding essentially, merely cases in which the windings are connected in such a manner that full pressure may be obtained as well from the entire current as from any two of the brushes indicated.

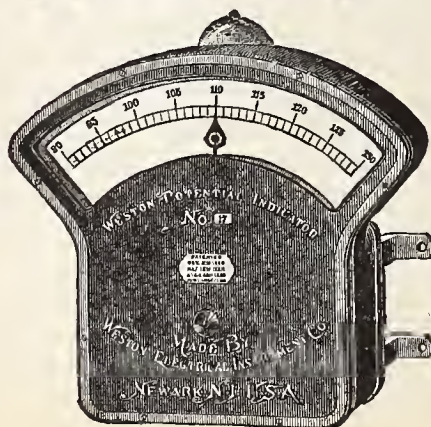
It would be very difficult to construct commutators and brushes of sufficient size to carry large volumes of current without heating; consequently in the majority of cases as many brushes as poles are used, thus reducing an otherwise inevitable expense in the construction of the commutator.

A multipolar dynamo is merely two or more dynamos

the prevention of heating, and the construction of the commutator are now so well in hand by electrical artisans that the heaviest machinery operates noiselessly, sparklessly, and without perceptible wear at the end of a yearly run. The science and art displayed in the different types of electrical machinery put upon the market by the Crocker-Wheeler Electric Company indicate a thorough grasp of the details of construction by those entrusted with that department of work.

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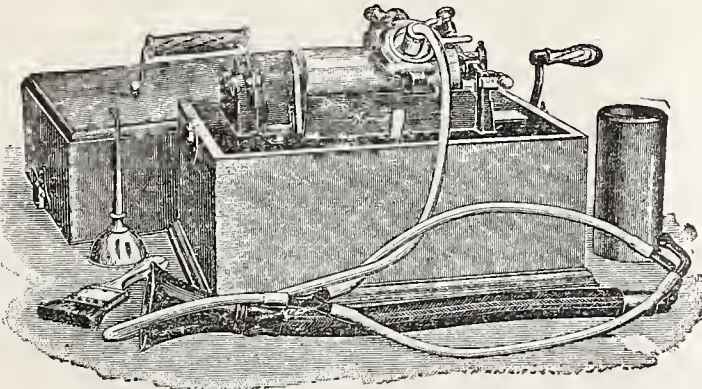
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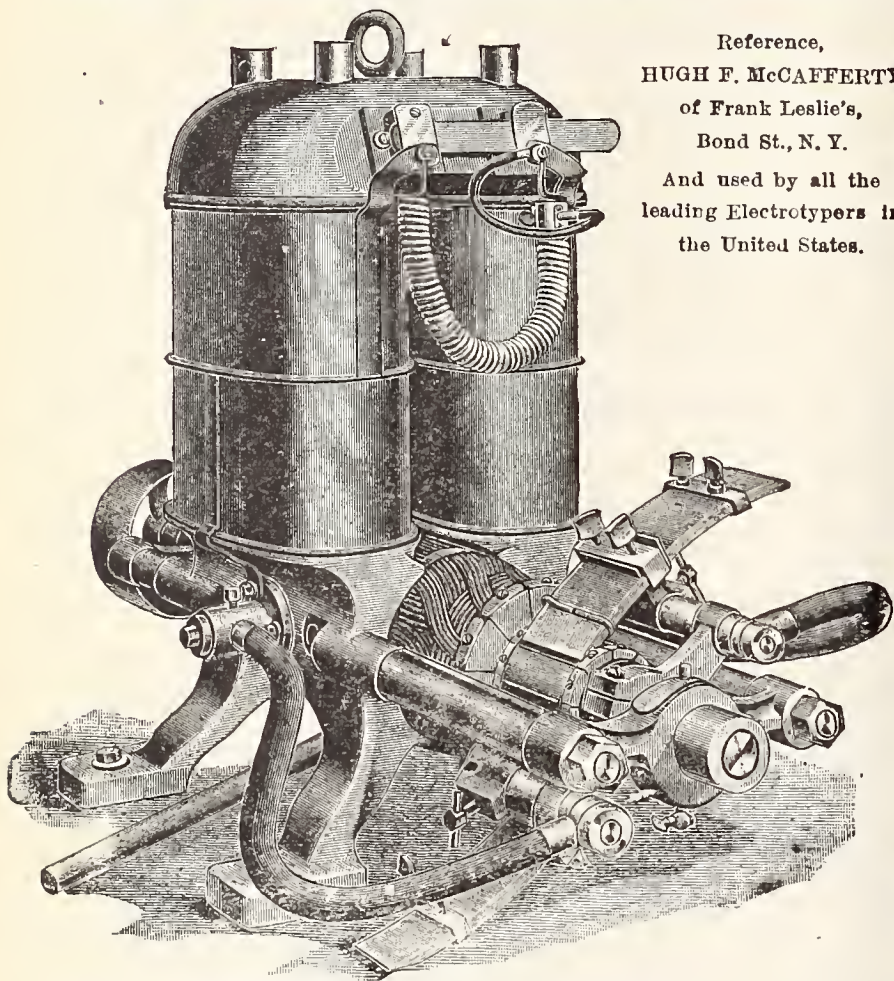
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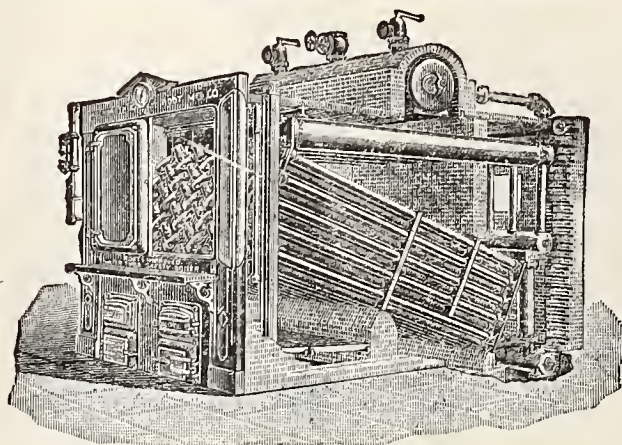
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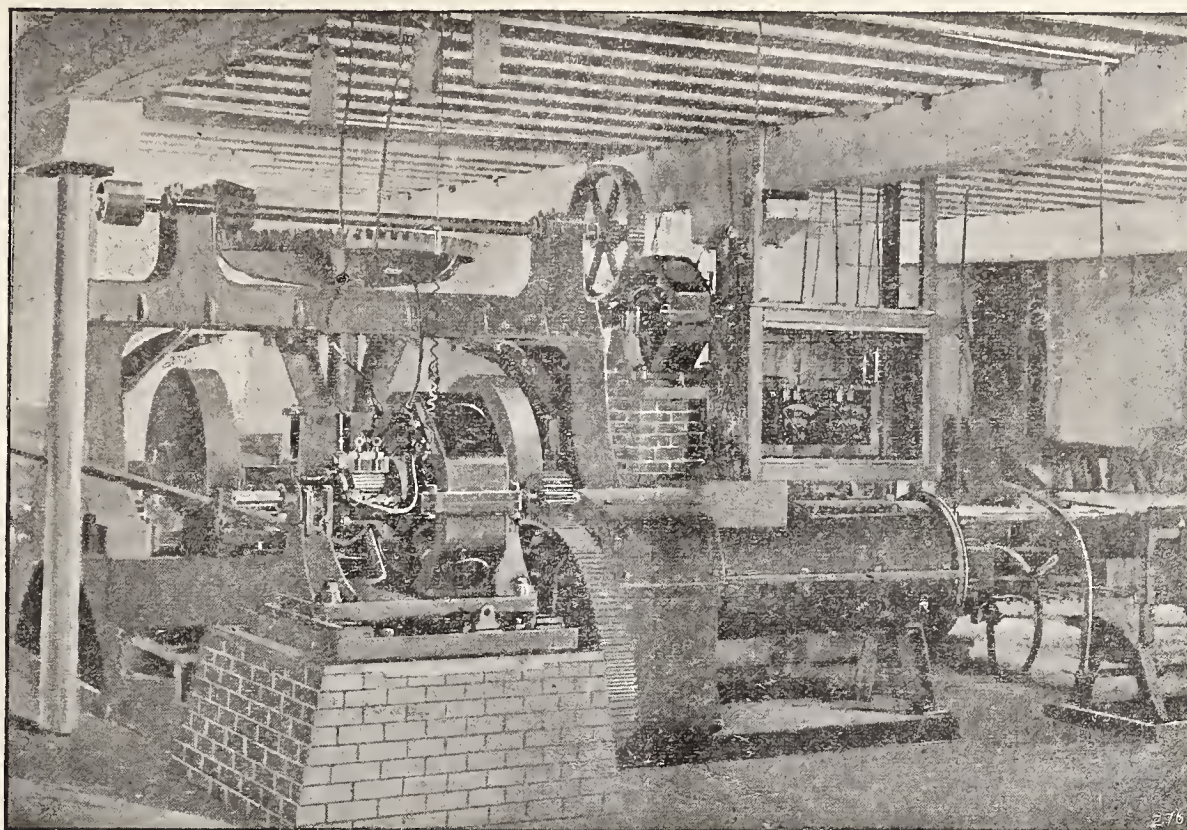
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The Electrical Age.

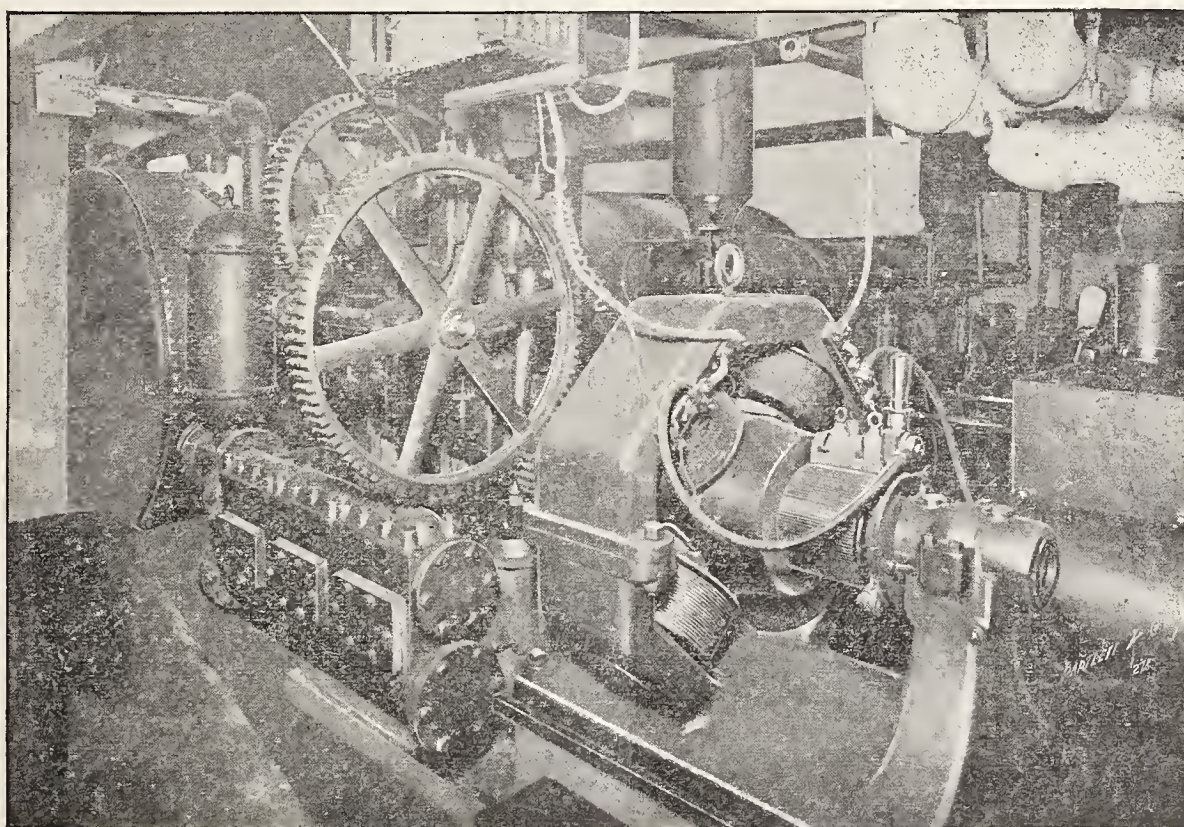
VOL. XXII—No. 4

NEW YORK, JULY 23, 1898

WHOLE No. 584



Motors on Brick Clay Mixer, Catsauqua, N. Y.



Motor on Triplex Pump, Granite City Steel Company, Granite City, Ill.

THE INCREASING USE OF DIRECT-CONNECTED MACHINERY FOR ELECTRIC LIGHT AND POWER.

The great change that has taken place in the department of electrical engineering in the use of direct-connected machinery is becoming more marked day by day. The application of electrical machinery to industrial purposes has exercised a great influence upon the development of certain industries and the cost of manufacturing. In many cases two lines of trade run parallel and become in the course of time dependent upon each other. It has been noticed by broad-minded critics that the gas-engine industry, like the refinement of mechanism in the high-speed steam-engine, should attribute a large share of its development and present perfection to the use of dynamos, in conjunction with which their sales have increased,

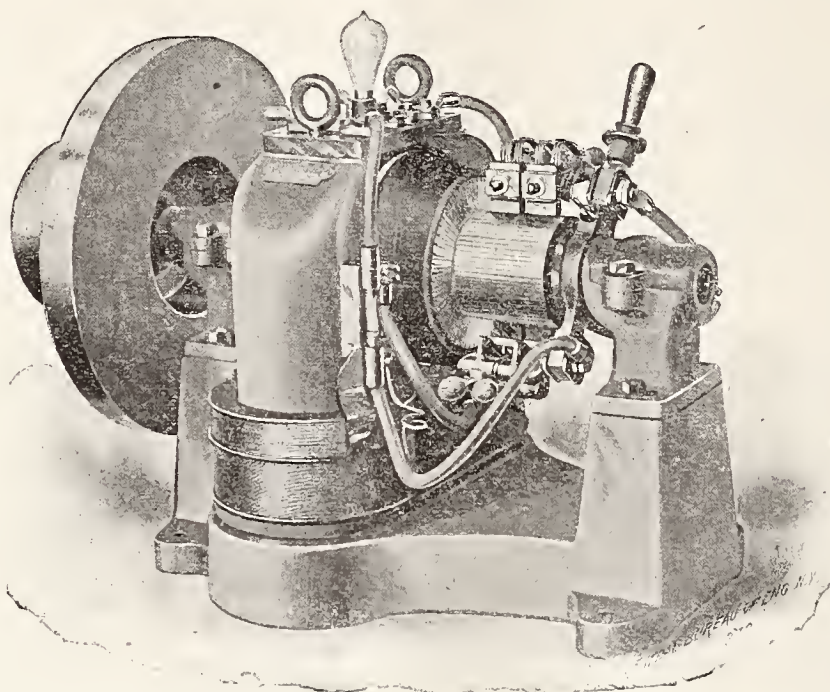
Certain modifications have been effected in the design and construction of motors and dynamos for direct-connected work. The dynamo, when driven by gas-engine, is frequently supplied with a fly-wheel belt pulley whose use is obvious. In other respects the dynamo is rarely, if ever, changed to meet external conditions, its normal construction being amply sufficient for all cases generally met with. The motor, however, has been greatly used in connection with air compressors, clay mixers, pumping machinery, etc. It is necessary to state right here that the direct connection of a motor to a piece of machinery is never a matter of trifling importance.

The general operation of the machine, pump, etc., to

which the motor is to be connected must be carefully studied and a true knowledge gained of the variations of load, its maximum and minimum, and the general economy resulting from the combination. It is not true that in every case the motor can be applied to a piece of machinery with a saving of far-reaching economy. Cer-

RARE MINERALS.

The best incandescent gaslight, the Auer light of the Auer Company in Berlin, has a mantle consisting of 99 per cent. oxide of thorium and 1 per cent. oxide of cerium. This small amount of cerium oxide increases

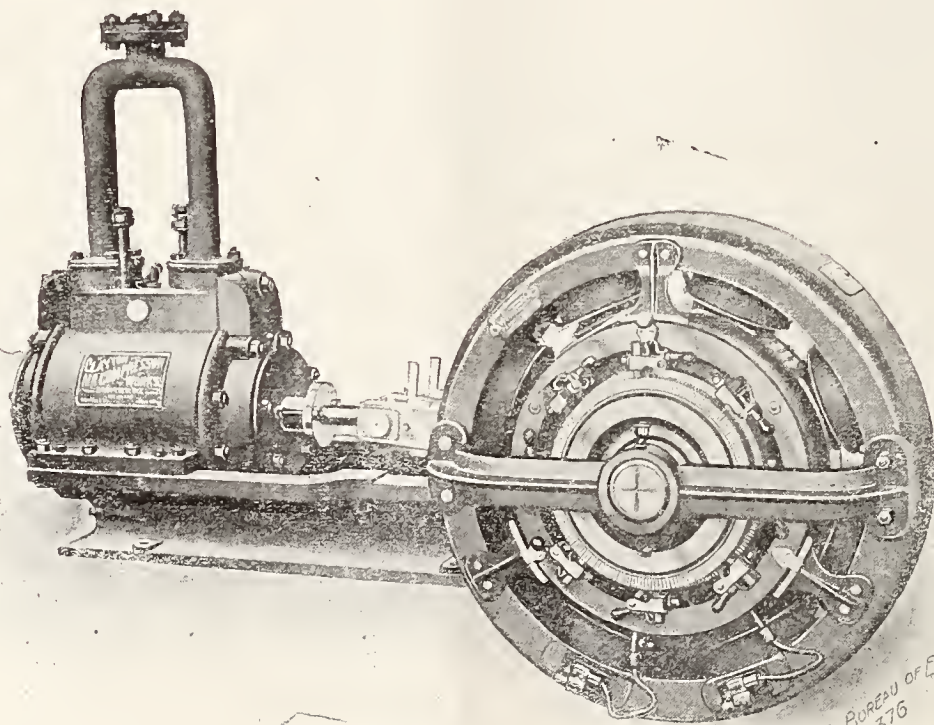


Compound Dynamo with Fly-Wheel Belt Pulley for driving by Gas Engine.

tain cases exist in which the use of the motor would involve complications and cause serious inconvenience to those entrusted with its care.

Machines operated by compressed air sometimes displace electrical machinery. Such cases as these are rare and their introduction and use is entirely due to the fact

the power of the mantle fifteenfold. "Invention," of London, also remarks that the most important minerals, from the point of view of the incandescent light trade, are thorite, orangite, and monazite, all of which contain both thorium and cerium. Others which are used are fergusonite, cerite, euxenite, columbite, etc.



Direct Motor connected to Clayton Air Compressor.

that fresh air such as compressed air machinery would deliver is necessary for hygienic purposes. The use of direct-connected electrical machinery for light and power is growing daily. Many of the obstacles that oppose progress have been swept aside by the inventive genius of our own people.

Westfield, N. J.—The Key West Electric Co. has been incorporated by Harry E. Knight, William E. Knight and David J. Newland. Capital stock, \$300,000.

Lyons, Mich.—An electric-light and power plant is to be constructed.

Monazite has a color varying from brownish yellow to yellow, thorite and orangite hovering between brownish yellow and orange. Most of the others are as black as pitch, opaque, and of a greasy lustre. The chief source of the three minerals was till lately southern Norway, in the neighborhood of the Langesund fjord, where they occur on the southwestern shore in veins of pegmatite, where they are associated with the red orthoclase which forms most of the vein. The felspar is exploited for porcelain making.

When the incandescent light caught on, in 1893, the price of minerals containing thorium naturally went up

enormously. Then a certain common mineral acquired, through a defective analysis, the reputation of containing thorium, and German agents bought up as much as they could get hold of at big prices. Poor people suddenly became rich, and a thorite fever raged in Norway. Everybody went out and hammered away at the rocks. Women sold the weighting stones of their mangles for large sums, stones were torn out of the walls of buildings, and nobody talked about anything but thorite. In time, however, an accurate knowledge arose of what minerals contained thorite and what did not. So far, Norway has only yielded between one and two tons of thorite and thorite containing minerals.

The price of thorite has been £25 per kilogramme, of orangite £30, and of monazite 30s. for the same weight, but, in spite of the great demand, the price of thorite fell to £4 per kilogramme, because the slender yield of Norway was supplemented by that of other places. In America considerable deposits of monazite sand have been found, and are now used for the preparation of thoria and ceria. In the State of Carolina there are hundreds of square miles of this deposit, averaging 18in. thick, but 13ft. in places. The thorium containing part of the sand averages about two per cent. of the whole, but 60 or even 85 per cent. of it has occasionally yielded thoria.

Unfortunately, monazite contains much more cerium than thorium, and the mantles have to contain more thoria than ceria. Very lately large deposits of monazite sand have been found in Brazil, and the necessary substances for mantle making are now made in large quantities, and works have been established for the purpose in Saxony at Glanchau, Oderan, and Duben. Minerals containing thorium and cerium have been discovered in some Russian, Canadian, and Australian rivers, and minute quantities of them occur in many parts of Germany.

CONSTRUCTION OF THE UNDERGROUND TROLLEYS IN SIXTH AND EIGHTH AVENUES.

Passengers on the Sixth and Eighth avenue street railroads were startled yesterday by seeing an announcement in bold, black type that the work of constructing the underground trolley would be begun next Wednesday. It was welcome intelligence to the travelling public, and especially to the Sixth and Eighth avenue merchants, who have been complaining that trade has been slipping away from them on account of the inadequate transit facilities afforded by the Metropolitan Street Railway in two of the principal thoroughfares of the city. They saw the promised land of real street cars before them, and they did not forget that the "Herald" had done much to make it visible.

Street car horses will be cheap, for pending construction no cars will be run. This will cause the travelling public some inconvenience, but they are disposed to bear present afflictions meekly in view of the relief which they see at hand. Besides, many of them would prefer walking to being jolted and rocked in the vehicles which have been in use. The cars seemed to grow a little more rickety with each year.

Many criticisms have been made of the policy of the Metropolitan Street Railway Company in delaying the work so long. The company has, however, had the iron work for both roads on hand for several months.

Contracts for the construction were let last Saturday. Contractors are now busy assembling their workmen and providing them with the necessary tools. Officials of the company are confident that the two roads will be in operation by September 15th. There have been heartburnings and jealousies on the part of the merchants of Sixth and Eighth avenues for fear that the other avenue would be first in the vanguard of progress. The company there-

fore promised that the two thoroughfares should be improved simultaneously.

It is expected that no extraordinary difficulties will be encountered. The work of constructing the Madison avenue electric line was delayed by the necessity of displacing sewer and other pipes. In Sixth and Eighth avenues there are no such impediments in the way. All that has to be done is to dig the trenches and place conduits and wires.

In the interest of the convenience of the travelling public the Metropolitan Street Railway Company gives notice that, although the horse cars on the Sixth and Eighth avenue routes will be discontinued on Wednesday morning, the passengers who ordinarily use them will have special facilities on its other roads. The electric railway which runs in Amsterdam and Columbus avenues now crosses the city by way of Fifty-ninth street. Beginning on Wednesday next, the electric railway in Eighth avenue north of Fifty-ninth street will also run across town, and transfers will be made from both these lines to the Broadway cable line at Seventh avenue, the Madison avenue electric line, the Lexington avenue cable line and the Second avenue electric line. For travellers west of Broadway additional facilities will be provided on the routes of the Seventh and Ninth avenue horse car railroads.

SOME PHASES OF THE RAPID TRANSIT PROBLEM.*

BY ALBERT H. ARMSTRONG.

(Continued from page 39.)

Another method would be to accelerate at a constant rate until maximum speed is reached, then continue this speed constant by supplying motors with just sufficient power to overcome train friction. This latter method of train acceleration, however, demands such a considerable increase in the amount of energy required for the run that it has not hitherto been considered.

The three methods of acceleration are illustrated in Fig. 5, showing the three forms of speed curves, a—a accelerating at a constant rate and coasting after maximum speed is reached until brakes are applied; b—b, accelerating at a constant rate and continuing at full maximum speed until brakes are applied, and c—c accelerating at a constant rate until starting resistance is cut out and further acceleration allowed to continue at a constantly decreasing rate with constant full line potential at motor terminals until maximum speed is reached, when train coasts until brakes are applied.

Curve a—a reaches the highest maximum speed but wastes the least energy in the brakes, and hence is the most efficient run mechanically, curve b—b, the constant-speed method, being the least efficient.

As these three curves were plotted from the speed-torque curves of an actual motor, it is instructive to compare the watt hours consumed for each run with series-parallel control, operating two motors in series, then in multiple. To this end a set of energy input curves have been plotted in Fig. 5, showing that curve c—c requires the least maximum energy input, while curve a—a requires the greatest amount.

The area enclosed by the energy time curves is a measure of the average energy consumption for each run, and their respective values reduced to watt hours are:

- Constant current and coasting, 147 watt hours per ton.
- Constant current and no coasting, 160 watts per ton.
- Constant current and acceleration on motor curve, 126 watt hours per ton.

Hence, of the three methods, curve c, making use of the acceleration due to a series motive curve, not only

requires the least maximum current input, but also requires the least average energy input to the motors for a given run, and hence is the form of curve used in the majority of actual runs. Although the energy given out by the motors in run c is greater than in run a, as evidenced by the higher speed at which brakes are applied, yet this extra work is done so much more efficiently, owing to the smaller starting loss, that the total watt hours input becomes less.

It will be noted that all curves of Fig. 4 approach a minimum value of thirty watt hours per mile; that is, the minimum energy expressed in watt hours per ton mile for a given run will be double the friction rate. The actual factor is 1.98 and forms a very convenient method of determining the net energy consumption for any speed and train weight if the friction rate be known. Thus, assuming the light load efficiency of a railway motor, including gear loss, to be 75 per cent., a friction rate of 15 lbs. per ton would demand an input of 40 watt hours per ton mile, corresponding to an input of 1,200 watts per ton weight of train, at, say, a constant speed of 30 miles per hour.

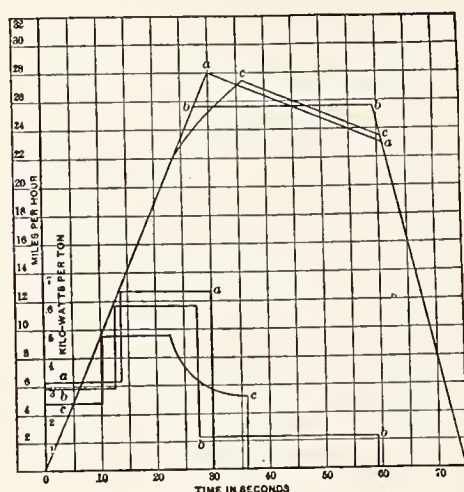


FIG. 5.—SPEED CURVES
Distance, 2000 ft. Time, 75 seconds. Friction, 15 lbs. per ton. Braking effort, 150 lbs. per ton.

A number of interesting conclusions may be made from the foregoing investigation of the operation of trains upon a level track.

1. The rate of acceleration determines the energy consumption for a given run, and since this energy consumption decreases with increased rate of acceleration, the train should be brought up to speed as quickly as possible and allowed to coast to secure the minimum energy input.

2. The maximum current input during acceleration increases with the rate of acceleration, and hence limits the rate at which a train can be accelerated with a given feeder loss or feeder investment.

3. In order to reduce the average energy consumption and also the maximum current input to a minimum for a given run, a due amount of acceleration should take place on the motor curve after starting resistance is cut out; hence a motor should be carefully proportioned for the work it has to do.

4. A normal amount of coasting should be permitted after power is shut off, partly to provide a margin to allow for errors of judgment of the motorman, but largely because this is the most efficient method of accelerating a train. On no account should the maximum speed be continued by supplying the motors with just sufficient current to overcome train friction, as this method of accelerating is very wasteful and inefficient.

Having discussed various methods of accelerating, it is interesting to follow out the problem and determine the actual efficiency of transporting passengers by our modern methods of travel. It has been pointed out that only

from 15 to 20 per cent. of a fully loaded train consists of a paying load, and with an average load as carried throughout the day this percentage will be reduced to 10 per cent. or less; that is, nine-tenths of the energy consumed in moving this train at a constant speed is wasted. But in rapid transit work a train seldom attains a constant speed, due to the frequent stops and high schedule speed, and at least ten times the energy required to overcome friction alone must be expended in accelerating the train, only to appear as heat in the brake shoes when bringing the trains to rest. That is, considering the friction work of the train as the only useful work done, an efficiency of only 10 per cent is reached in the average run. But only 10 per cent of this friction work is useful in moving passengers; hence the actual passenger efficiency is reduced to less than 1 per cent. of the total energy delivered to the train during acceleration.

When it is considered that further losses occur in operation in the motors and their method of control, in the transmission lines and generators of an electric traction system, it will be appreciated that the present method of

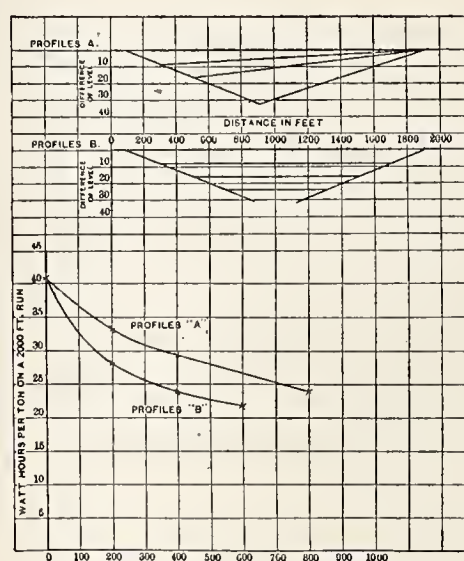


FIG. 6.—ENERGY CURVES ON ARTIFICIAL PROFILE

transportation, with its efficiency of a fraction of 1 per cent., opens a wide field for improvement. This applies with greater force to rapid transit service using steam locomotives as a motive power, as the dead weight carried per passenger is greater with a steam locomotive than with a motor car, and the efficiency from the coal pile is much less. Hence some means of reducing the large loss due to accelerating the train is desirable, and this is found in the adoption of an artificial profile, as followed out in a large underground road now building, using down grades in starting and up-grades to retard the train when stopping.

The ideal profile would provide for a down-grade at starting sufficient to do the work of acceleration and with an up-grade to do the entire braking required, thus leaving only the friction energy to be supplied by the motive power. Such a road would operate at 100 per cent. efficiency, neglecting the dead weight of train carried and considering total friction work as useful work.

Reduced to practice, this ideal grade must be modified considerably. The per cent. grade used is limited partly by the rapidity of acceleration that may be imparted to the train without discomfort to the passengers, and partly by the available tractive effort of the motive power, which must be sufficient to haul the train up the grade in case of necessity.

(To be continued.)

Harriman, Tenn.—D. W. Thomas, city clerk, may give information concerning construction of an incandescent-light plant.

ELECTRIC TRACTION.

NOTES ON THE APPLICATION OF ELECTRIC MOTIVE POWER TO RAILWAY SERVICE, WITH ILLUSTRATIONS FROM THE PRACTICE OF THE METROPOLITAN ELEVATED ROAD OF CHICAGO.

BY M. H. GERRY, JR.

(Concluded from page 36.)

The speed of a series railway motor at any given impressed E.M.F. is fixed by the total resistance of the train. The horizontal effort developed must just equal the resistance, or the velocity will change; therefore, if it be desired to maintain a constant speed, or to vary the velocity in any manner not corresponding to the fixed relations of speed and torque for the particular motor and voltage, it will be necessary to alter the impressed E. M. F., or to commutate the fields. To obtain this variable E.M.F. at the motor terminals from the constant E.M.

generators or of the problems connected with railway feeders, might well be the subject of a separate paper. It is designed here simply to touch upon a few points relating to the general system.

Railway generators at the present time are nearly all of a direct current type, but there is reason to believe that in the future two and three-phase alternating current machines will be installed. The development of the rotary transformer will be largely responsible for this change in practice. Power stations can be more favorably located in respect to fuel and water supply, and through sub-stations furnish power to larger areas. With this change will come also greater economy in the production of power, which cannot but have a favorable effect on the development of the electric railway.

The commercial efficiency of railway generators varies from 90 to 95 per cent. Under favorable conditions, the average or "all day" loss for large direct-connected machinery (units of over 600 K.W.) is about seven per cent. Direct-connected alternating current generators give about the same efficiency as direct current genera-

No. of trip.....	1	2	3	4	5	6	7	8
No. of cars in train.....	4	4	4	3	3	2	2	4
Total time of trip.....	28'26"	29'03"	28'30"	28'37"	27'26"	25'30"	23'48"	32'44"
Total time of stops.....	2-19	2-05	2-42	1-47	1-16	0-54	1-22	1-41
Time running.....	26-07	26-58	25-58	26-50	26-10	24-36	22-26	31-03
Average speed (including stops)..	13.3	13.0	13.2	13.88	14.4	14.9	15.9	11.53
Average speed (not includ. stops)	14.4	14.0	14.5	14.7	15.1	15.3	16.8	12.2
Average current (including stops)	138.3	142.6	138.6	130.2	129.5	90.1	106.6	101.1
Average current (not includ. stops)	148.7	153.2	151.8	137.4	135.6	92.5	112.4	106.4
Average volts (at the train).....	504	498	503	512	516	521	529	509
Efficiency from generators to car axles.....	51	50.5	52	50	51	51.5	50	47.5
Kilowatt hours per car mile (at the train).....	1.32	1.36	1.32	1.69	1.62	1.58	1.76	1.11
Kilowatt hours per car mile (at the station).....	1.44	1.52	1.44	1.81	1.68	1.67	1.69	1.21

F. of the line, many arrangements have been proposed, but only two are in use to any extent. They are by rheostat in the main circuit, and by grouping two or more motors in series and parallel combinations. Practically, the two methods are combined and are now in nearly general use. The rheostatic method wastes the energy represented by the reduction in voltage, and the series-parallel arrangement provides two or more voltages at the motors without preliminary loss. The controllers in use on the Metropolitan are two combination series-parallel and have three steps on the rheostat for each voltage. The losses in this apparatus vary from 10 to 20 per cent., depending upon the skill with which it is handled. With care this can be kept down to 10 per cent., making no allowance for the reduced efficiency of the motors at the lower voltages. The series-parallel system has decided advantages over all other methods thus far tried in practice, but it lacks flexibility and ultimately may not prove to be the best for heavy railway work and especially for high speed service.

The selection of the proper motors and controlling apparatus for a given service deserves more attention than it has generally received. The horse-power and maximum speed have too often been the determining quantities. A rating based on horse-power is now understood to be of little value, and the maximum speed of which a motor is capable may be of still less account as representing its performance with a train. Quite generally, motors have been speeded too high, the result being insufficient starting torque, a poor commercial efficiency and less average speed than a better selected motor would have developed.

The Generators and Feeder.

Anything like a complete discussion of modern railway

tors. Commercially, the best results are obtained with a few units of large size. It is unnecessary and poor practice to install many small units for railway work.

The load line of an electric railway is subject to two kinds of fluctuations; first, those sudden changes caused by the starting together of a number of trains, and secondly, the more gradual change due to the variation of traffic at different hours of the day. On roads operating but few cars, the fluctuations due to the first cause are of considerable amount, but on large systems with many cars the changes in loading from starting up of trains are very slight—hardly noticeable, in fact—and this is especially the case if the feeders are tied together and form a network. There still exists, however, the change in the load line corresponding with the traffic. A railway load line differs from that of a lighting station in having two nearly equal "peaks" or points of maxima, one in the morning and one in the evening. These variations are best taken care of by cutting in and out units, while the momentary changes can usually be cared for by a slight overloading of the machinery. Engines and generators for railway purposes have a good efficiency over quite a wide range and generally stand overloads very well. In Fig. 12 are shown seven load curves from the power station of the Metropolitan Elevated. The curves correspond to the days of the week and indicate the average power taken, but do not show momentary fluctuations, caused by the movement of trains. The chief characteristics of these curves are the two decided "peaks" occurring daily with great regularity. The peaks vary as to amount and time, with the season of the year, and to some extent with the weather, but are always present in a marked degree. Street railway systems with many lines extending to different parts of a

city, usually show a station load with less decided and broader peaks. This is due in part to the habits and occupations of the patrons of the various lines which determine the hours of maximum traffic. When combined, the load curves from a number of such lines will give a more favorable station load than any one line or group of lines in the same section of a city.

The load curves of the Metropolitan have proven to be a very sensitive index of the traffic. A delay on the competing cable lines or increase of travel from any cause is at once noticeable in the power house. The greater station loading is due not so much to the increased weight in passengers carried, as to the longer stops necessary to discharge and to take on passengers; thus requiring a higher speed to keep the trains on time.

The feeder system has an effect upon the form of load

quarters at all times. In the table below are given the efficiencies for a number of direct-connected machines of modern design.

Type of Machine.	Commercial Efficiency.			
	Full load.	$\frac{3}{4}$ load.	$\frac{1}{2}$ load.	$\frac{1}{4}$ load.
D. C. Generator, 700 K.W.....	94	93	92	—
D. C. Generator, 750 K.W.....	93.5	92.5	91	85
D. C. Generator, 800 K.W.....	96	95	92	—
D. C. Generator, 1,500 K.W.....	94.5	94	93	—
A. C. Generator, 750 K.W.....	94	93	91	—
A. C. Generator, 600 K.W.....	93.5	92	87	82
A. C. Generator, 700 K.W.....	94	92	90	83
A. C. Generator, 650 K.W.....	93.5	91.5	89.5	—
Rotary transformer, 650 K.W.....	94	92	90	—
Rotary transformer, 600 K.W.....	95.5	92.5	90	84

With machines of this type and size, the all day efficiency ought to be about 92 per cent. A sub-station pro-

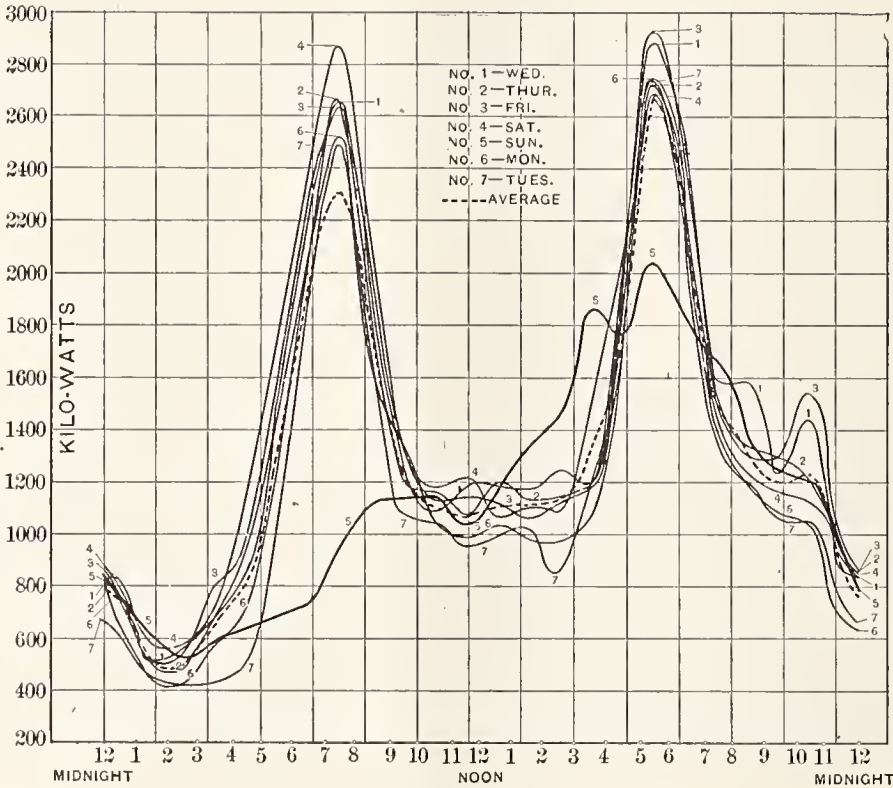


Fig. 12.

curves as well as upon the total amount of energy required. The highest percentage of loss will occur at the moment of greatest loading, but this rarely takes place at the same time on different sections, and an advantage is obtained by connecting the lines together to form a net work as far as possible. Feeders are usually divided into sections as a matter of safety and convenience. The best economy of copper and of power, and the most favorable road lines are obtained when the number of such sections are as few as consistent with the safety and flexibility of the system. When feeder sections are connected, the best practice calls for a fuse or circuit breaker in this circuit. The permissible percentage of loss between the power house and the trains is partly a commercial question, depending on the cost of power and interest on the feeder investment. Transformers, rotary converters, boosters, batteries, and similar apparatus forming a part of the feeder system, should be considered with special reference to cost, operating expense, all day efficiency and effect on the load factor of the generating station.

The Efficiency of Transmission.

The energy dissipated between the engine and the car axles may be divided into three parts, that lost in the electrical generators, the losses in the transmission lines (including transformers, rotaries, etc.) and the losses in the car controlling apparatus and motors.

The amount of loss in the generators will depend upon their efficiency and average loading. Modern railway generators have good efficiency above half load, and in stations designed with reference to the load line, there is but little difficulty in keeping the machinery above three-

vided with rotaries and static transformers working under a good average loading, should have an efficiency of about 89 per cent.; a loss of 8 per cent. in the rotaries and 3 per cent. in the transformers. The sub-station apparatus is at its highest efficiency at the time of greatest loading, when the feeder lines are at the lowest efficiency and thus have a favorable effect on the load line.

The losses on railway feeders vary from 10 to 25 per cent. Often there is sufficient copper if rightly distributed and tied together to reduce this at least one-half. Such a change would also improve the load factor and increase the efficiency of the station. The losses in the motors and car apparatus have already been referred to in this paper, but actual data and tests are here introduced in evidence.

From a large number of tests made on the trains of the Metropolitan Elevated Road, the following have been selected as illustrating this part of the subject. The trips are numbered from one to eight, and in the table below the data for each trip are given, together with the general results obtained. All of these runs were made on a dry track, in moderate weather and under average working conditions. The total electrical energy at the train was measured by Thomson recording wattmeters and the voltage and current by Weston instruments. The velocity record was taken from a Boyer speed recorder and the stops and average speed from a double set of stop-watches. The pressure at the station was measured by a recording voltmeter.

Trip No. 1 was made from Franklin street over the Logan Square line with a four-car train, heavily loaded, making an average running time of 13.27 miles per hour.

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THE INCREASED CONSUMPTION OF COAL BY ELECTRIC LIGHT PLANTS.

The rapid consumption of coal in America and Europe has caused some concern to those interested in matters of vital importance to the human race. The dependence which we place upon our coal mines has become so great in the past fifty years that if the supply should suddenly cease the wheels of commerce would stop, and the civilized races, horrified at the prospect of eternal labor, would be plunged into unutterable grief. The coal fields of Great Britain may not last more than a century. Her miners are already burrowing under the ocean's bed for the precious fuel. The mines in India and South Africa, upon which her future hopes are founded, are undeveloped. Germany, France, Italy, and even Russia, have little or no coal to spare. The United States stands alone in the possession of vast coal fields of seemingly unlimited extent.

The great electrical industries have had a great deal to do with the enormous annual consumption of coal now going on. An authentic report on the mineral industries of this country shows that New York city in 1897 consumed 1,850,000 tons of bituminous coal and 3,300,000 tons of anthracite. The city of Philadelphia in the same year used 3,190,000 tons of anthracite and 920,000 tons of bituminous. Other large, well known cities used the following enormous quantities: Chicago, 1,420,000 tons of anthracite and 3,220,000 tons of bituminous; Brooklyn, 1,800,000 tons of anthracite and 200,000 tons of bituminous; and, finally, Boston, 1,240,000 tons of anthracite and 525,000 tons of bituminous. It is, of course, understood that a percentage of this coal is used by the various manufacturing concerns of the above-mentioned cities, but a very heavy percentage of it is burned by electric light, power and street railway companies.

In the mining of coal, from one-third to one-half is wasted. Every ton transported represents from a ton and a half to two tons that has been mined, but through

waste and other losses the available amount is comparatively small. Fuel consumption in our large cities and in the smaller towns is increasing year by year. The millions of tons of coal annually consumed will grow and multiply enormously in the next twenty years. Any method of consequence devised for the purpose of aiding the economical consumption of coal will add largely to the future happiness of this race by setting further away the date of its final consumption. Fortunately the ingenuity of the Yankee mind has brought into being innumerable devices of a coal-saving nature, which certainly reduce the annual consumption to figures much less than they would be were their application not appreciated.

The ownership of coal is the ownership of power. Modern warfare has shown that coal is the open sesame to all ports. Gold is the symbol of power, but the power itself, the actual force and strength of nations on the high seas and on land, is coal.

The electric light and motor, the great iron foundries and factories, are chewing up coal, as we see, at the rate of millions of tons a year. It cannot last forever, and our only hope is that some new genius will arise and show us how to wrest a small quota of energy from the infinite storehouse of nature.

X RAYS FOR TESTING COAL.

The Paris Academie des Sciences received a communication from M. H. Couriot regarding the application of X rays to coal. M. Couriot believes in testing coal for the purpose of showing its salicuous formation. The test of the different grades of coal by this means is a remarkable one, the slag and clinker forming elements appearing upon the screen quite distinctly. M. Couriot has tested anthracite, lignite, coke, peat and block fuel in this manner. Almost invisible specks of silicate appear on the screen and traces of other impurities. It is curious to see the particles of iron sulphide in coke and the conglomerate formation of block fuel.

Coal is absolutely transparent to the X rays. Photographs taken by M. Couriot merely show a rude outline of the lump under inspection, with a variety of specks and streaks passing through the piece in all directions. The roughest chunks are just as serviceable in this test as though carefully hewn into shape, but the main object and value of this method in indicating the presence of impurities should lead to its universal adoption by all large and progressive coal dealers.

THE RATIO OF HUMAN PROGRESS.

At the last meeting of the British Association, Mr. George Iles read a suggestive paper, "Why Human Progress is by Leaps." He points out that the triumphs of man over nature in the discovery of its laws of action are not simple additions to his resources, but are multipliers of high potency, often extending over the whole field of his activity. This he illustrates by the manifold applications of electricity in our own day, and by the use of fire in prehistoric times. He draws the conclusion that man's advance will in the future be at a continually accelerated pace.

This reasoning is closely akin to that of Lewis H. Morgan in the chapter on the rate of human progress in his "Ancient Society," New York, 1878. He there argues that culture-progress proceeds by geometrical, not arithmetical ratios; which is substantially Mr. Iles' position.

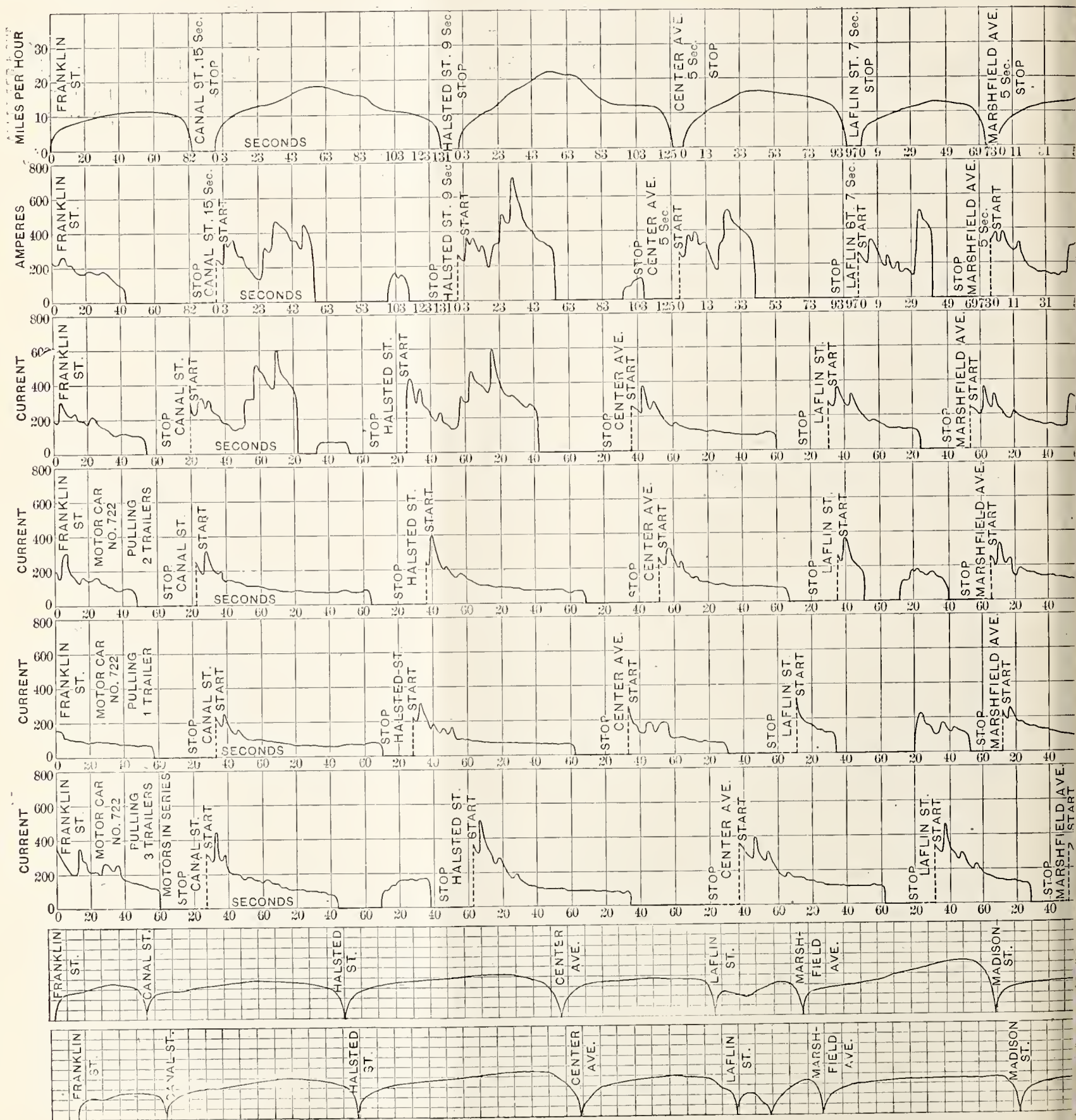
It should be borne in mind, however, that true culture cannot be measured by criteria drawn solely from the utilitarian arts. Civilization has been nicely defined by a French writer as a "state of mind," rather than a schedule of possessions; and this is singularly true.—Science.

The maximum grade on this line, going west, is 0.75 per cent. ascending for about 2,350 feet, and descending for about 1,950 feet. Other grades do not exceed 0.03 per cent. and only extend short distances. Current and speed diagrams on a time basis are plotted in Fig. 13 for trip No. 1. The current is the total amount taken by the train for power, and an inspection of the diagram will readily show the point of passing from series to multiple. The amount of energy required or absorbed by the train is as follows:

Average volts at train.....	504.
Average watts at train.....	6,9678.
Electrical horse-power transmitted to the train.....	93.4.
Average volts at the station.....	545.
Average watts at the station.....	75,346.
Electrical horse-power at the station.....	101.
Efficiency from electrical generators to car axles.....	51 %.

Assuming the commercial efficiency of the generators as 93 per cent., the total power required at the engine shaft to propel this train is 108.5 horse power.

Trip number 2 was made with a four-car train, under



Total energy for accelerating the train.....	30,940,000 ft. lbs.
Total energy for train resistance.....	14,110,000 ft. lbs.
Total energy for grade.....	3,400,000 ft. lbs.
Total energy required for propelling the train...	48,450,000 ft. lbs.
Per cent. of energy for accelerating.....	63.9.
Per cent. of energy for train resistance.....	29.1.
Per cent. of energy for grade.....	7.0.
Time of trip, including stops.....	28 min. 26 sec.
Average H. P. required for propelling train.....	51.5.
Average amperes of current.....	138.25.

similar conditions to trip number 1. A current curve on a time basis is given for this trip in Fig. 14. In all of the current curves, it is easy to distinguish by inspection when the motors are in series and when in multiple. The stops on the controlled are also distinguished by the greater peaks on the curves. The smaller peaks and other irregularities are due, principally, to changes in voltage, caused by other trains in the same section taking more or less current.

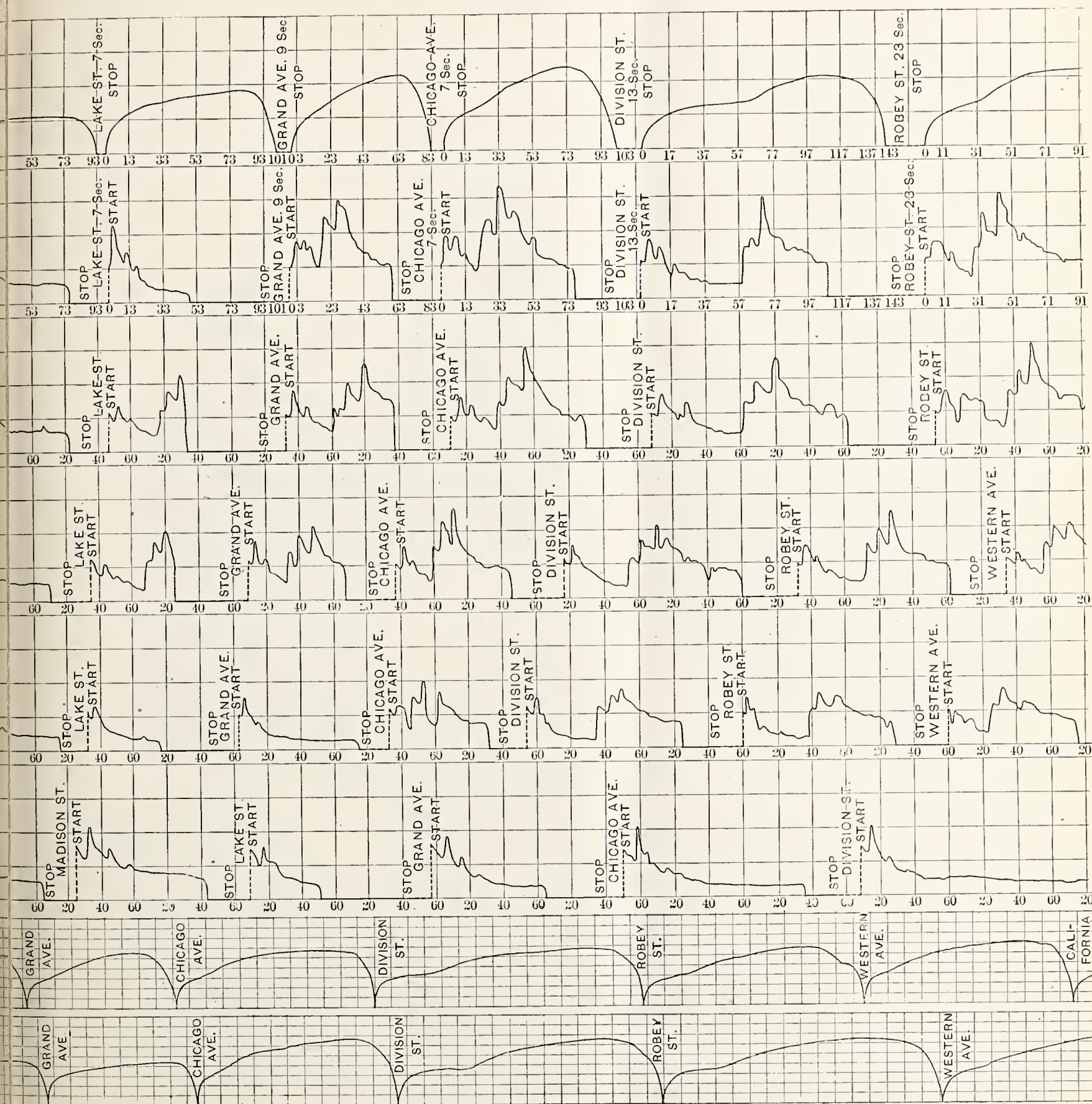
Trip No. 3 was made under similar conditions to trips 1 and 2, and the data and results are given in the table.

Trip No. 4 and 5 were made with heavily loaded three-car trains and the results are set forth in the table. Both the speed and commercial efficiency of apparatus are higher than in the case of the four-car trains. A diagram of current on a time basis for trip No. 4 is given in Fig. 15, and a speed curve on a distance basis in Fig. 18.

Trips No. 6 and 7 are with two-car trains and show a higher speed than attained in the case of the three and

speed, but this is due, not to a better efficiency of the apparatus at lower speeds, but to the fact that the amount of power required to propel a train making many stops decreases more rapidly than the average speed. The current diagram for the trip is given in Fig. 17.

The amount of power lost in the machinery and line, as indicated by the commercial efficiency of the apparatus given in the table, might seem at first thought to be large, but considering the transformation and the distance of transmission, it is certainly not excessive. The



four-car trains. The greater amount of power consumed in trip 7 is due, mainly, to the increased speed over trip 6. A current curve for the latter trip is shown in Fig. 16, and a speed curve in Fig. 17.

Trip No. 8 was made with four loaded cars and the motors operating only in series. Both the speed and current are less than for similar trips with the motors operating in series and multiple. The percentage of power saved is greater than that of the reduction in

loss in this respect is offset by the smaller cost of producing energy by power-house methods. The train weight also may be reduced with electric power to a point impossible with steam locomotives, and the rate of acceleration increased, and thus a saving effected in power used at the train. While this does not improve the efficiency of the transmission, it reduces the total amount of power required, and as a feature of the system it should be given due credit.

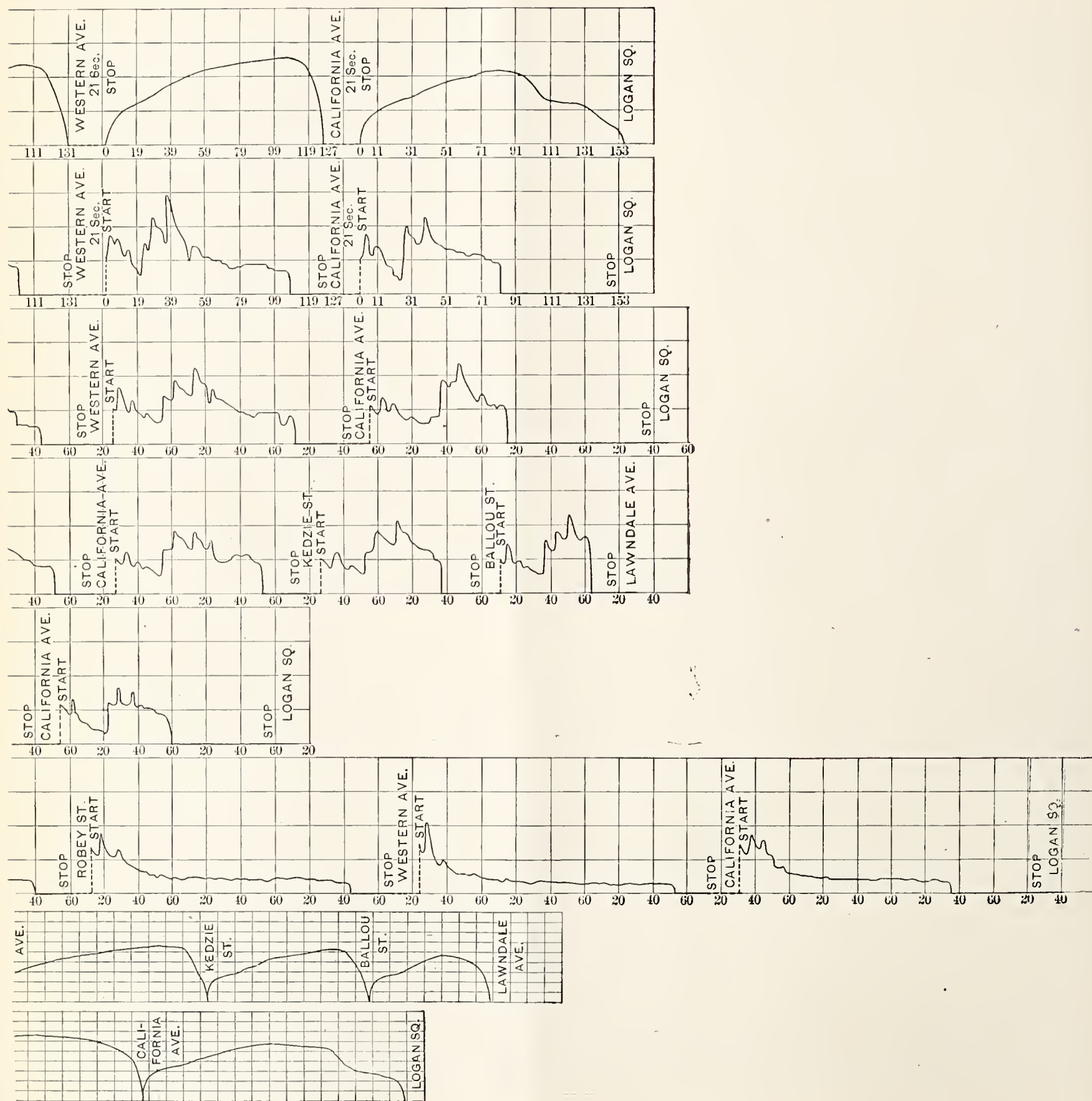
Electrical energy can be produced in the vicinity of Chicago, with cheap coal, under the conditions of a railroad load, at less than half-a-cent per kilowatt-hour, and in the form of mechanical energy at the car axles, costing about one-cent per kilowatt-hour, it is several per cent. cheaper than it can be generated by steam locomotives. Add to this the actual saving in energy from a more rapid acceleration and from reduced train weight, and the total direct advantage for the electrical system is obtained as far as economy in power is concerned.

NEW YORK ELECTRICAL SOCIETY.

The following members of the New York Electrical Society who have changed their residence are requested to send their new address to the Secretary, 120 Liberty street, New York City:

B. F. Sherman,
R. S. Dobbie,
D. D. Book,
H. Van Sands,

L. J. O'Reilly,
A. V. Waldron,
Harry Cette,
C. A. Thompson,



While any reduction in the cost of power (not only for fuel, but repairs, labor, water, oil and waste, etc.) is of great importance to railroads, the many other advantages of electricity, representing betterments of the service and greater earning capacity are the chief qualities which will determine its adoption in any case in place of steam locomotives. As a motive power electricity is simple, efficient and wonderfully flexible, and it is hardly wise to predict its limitations.

Fred Reed,
C. W. Raymond,
W. F. Collins,
C. E. Hart,
J. Egan,
G. C. Webb,
D. H. Washburn,
J. C. Harris,
W. Schwein,

E. E. Stark,
J. T. Palmer,
T. F. Grover,
J. C. Henry,
J. W. Doyle,
R. A. Varley,
C. H. Wright,
C. C. Gartland,
John Deane, Jr.,

A. S. Miskin,
J. W. McLogan,
Meno Fedden,
W. A. Giles,
Thos. Bennett,
T. A. Fowler,
S. S. Harris,
C. E. Chinnock,
R. Crawford,
A. C. Greenburg,
B. F. Card,
A. B. Bennett,
N. Hall,
J. D. Underhill,
J. A. Cabot,
W. E. Lamb,
E. Denning,

F. E. Dolbier,
C. A. G. Groenbeck,
Jas. Stewart,
C. F. Green,
M. W. Grovesteen,
G. Arnold,
J. S. Cobb,
D. H. Starralt,
E. Voelckel,
G. R. Shepard,
W. L. Tamblyn,
A. Stamm,
C. J. Bickley,
H. B. Niles,
J. McMahon,
E. S. Reid,
J. H. Longstreet,



Application of the Multiphase

R. A. Mitchell,
R. Leichman,
H. A. Dingle,
C. Herman,
Leo Bock, Jr.,
H. F. Salamons,
A. G. Holcombe,

M. B. Meddler,
C. P. Gott,
A. C. Barrett,
A. W. Steiger,
E. C. Miller,
A. McKinnon,

J. JONES & SON report the receipt of a large foreign order for goods of their manufacture, which will keep their factory busy for some weeks.

Rossland, B. C.—The "Miner" states that a new project is on foot to supply the mines with electric power. The promoters propose installing dynamos at the Kootenay Hydraulic Mining Company's plant on the Pend d'Oreille, back of Waneta, and transmitting electricity to Rossland, a distance of 17 miles. At the outset the plant will have a capacity of 750 horse-power, but will be so constructed to permit of greatly increasing this power. About \$170,000 has been subscribed towards the enterprise, and there are still some 200,000 shares of stock yet in hand. Orson D. Archer & Son, of New York, are the eastern representatives of the project.

PROTECTION OF BUILDINGS FROM FIRE.

The efficiency of the multiphase cable has been tried on many occasions in a most satisfactory manner. According to the "Insurance Press" the Suburban Underwriters' Association, on June 28th, 1898, increased the rebate allowed for the auxiliary fire-alarm system to ten per cent. when the boxes are connected by multiphase wire. The underwriters are never better pleased than when they discover the fire-alarm system installed in a building to be automatic and reliable. The reliability of many contrivances used for the purpose of bringing an alarm has been doubted in many cases, but a change of opinion has taken place in favor of the multiphase cable, manufactured by the Montauk Multiphase Cable Company, of 100 Broadway, New York City.

Our readers are probably well acquainted with the virtues of this cable, particularly those that visited the Electrical Exhibition at Madison Square Garden, at which the above company showed by practical experiments the superior value of their cable and its method of application. It seems as though further argument is totally unnecessary when the authorities on the subject of fires, the un-



Cable in the Home and Factory.

derwriters themselves, fully believe in the advantages of the Montauk system.

The multiphase cable used in connection with the auxiliary system really places a house under surveillance of the most constant nature. It is practically impossible for an undue rise of temperature to occur in any portion of the building without operating an alarm. In those rooms most susceptible to the influence of fire, auxiliary boxes placed in each of them connected by wires, as shown in illustration, would operate instantaneously at the appearance of fire at any point. The alarm is immediately sent to headquarters the instant flame touches the wires, assistance proceeding from this centre to the building requiring assistance. By a combination of the multiphase cable and the Gamewell auxiliary system a building practically looks out for itself as though endowed with intelligence, ringing its own alarm, giving its number and location and calling for aid as loudly and emphatically as though animate with conscious life.

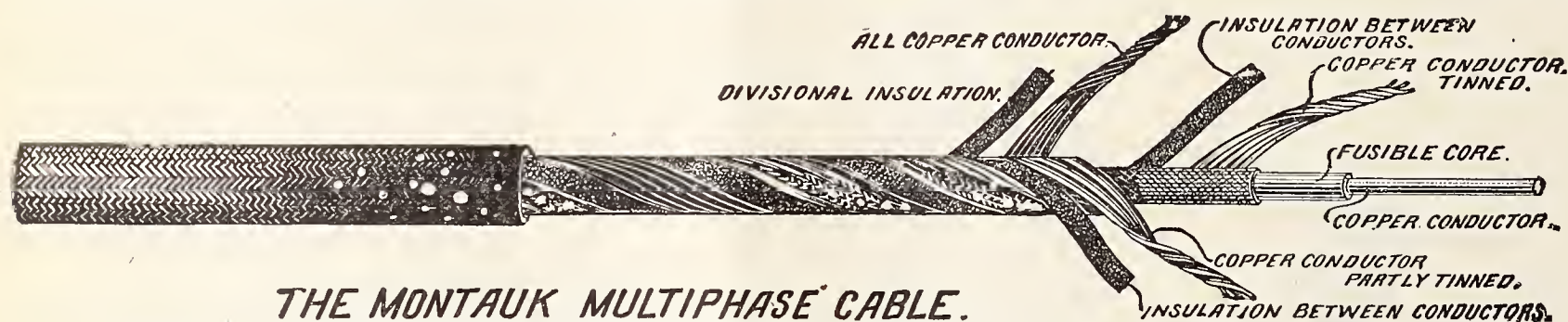
The "Insurance Press" mentions in an article called "A Great Advance in Fire-Alarm Telegraph Protection" that "the managers of the auxiliary automatic alarm do not intend to come into competition with the established thermostatic central offices, but in furnishing automatic alarm facilities in the vastly larger territory in which the

central office systems for reasons stated have never operated they will inaugurate a new era of improvement in fire-alarm telegraph facilities which will doubtless be as readily welcomed by all fire underwriters as it has been by the Suburban Underwriters' Association."

The illustrations in this article show the cable dissected, a factory room beginning to blaze, and the hotel indicator system. The general application of this system for suburbanites is invaluable in its wonderful protective power and immediate aid to those in want of assistance.

THE LIQUEFACTION OF HYDROGEN.

Fuller particulars regarding the liquefaction of hydrogen and helium by Professor Dewar have come to hand in his paper in the *Proceedings* of the Chemical Society.



THE MONTAUK MULTIPHASE CABLE.

SHOWING FUSING EFFECT AFTER CONTACT WITH DANGEROUS HEAT OR FLAME.

As early as 1895 Dewar had constructed an apparatus by which he could produce a jet of hydrogen containing liquid. It was then shown that such a jet could be used to cool substances below the temperature which could be reached by the use of liquid air. A much larger apparatus of the same type was then constructed, in which the liquid-air plant was combined in its circuits and arrangements for the liquefaction of hydrogen. The construction of this apparatus consumed a year, and many months were occupied in preliminary trials and tests. On May 10th hydrogen was liquefied by allowing the gas, cooled to -205° , and under a pressure of 180 atmospheres, to escape continuously, at the rate of ten to fifteen cubic feet per minute, from the nozzle of a coil of pipe in a double silvered vacuum vessel of special construction, surrounded by a space kept below -200° . Liquid hydrogen commenced to drop from this vacuum vessel into another doubly isolated by being surrounded by a third. Twenty cc. liquid hydrogen were obtained before the hydrogen jet frozen up from the solidification of the air in the pipes. Liquid hydrogen is clear and colorless, showing no absorption spectrum, and the meniscus is as well defined as in the case of liquid air. It has a relatively high refractive index and dispersion, and its density appears to be in excess of the theoretical value 0.18 to 0.12, deduced from its atomic volume in organic compounds, and the limiting density found by Amagat for hydrogen gas under infinite compression. Dewar's experiments have given a density of 0.62 for hydrogen condensed by palladium, and this may not be far from the value for the liquid. No arrangements were at hand to determine the boiling point of hydrogen, but it must be excessively low, for a long piece of glass tubing sealed at the lower end and cooled by immersion in liquid hydrogen immediately filled with solid air where it was cooled. A tube of helium from the Bath gas was placed in liquid hydrogen, and a distinct liquid was seen to condense, thus showing that there cannot be any great difference in the boiling points of hydrogen and helium. All known gases have now been condensed to liquids which can be manipulated at their boiling points under atmospheric pressure in suitably arranged vacuum vessels. With hydrogen as a cooling agent, it will be possible to get within 20° or 30° of the absolute zero, and its use will open up an entirely new field of scientific inquiry.

In seconding a vote of thanks to Professor Dewar, moved by Sir William Crookes, Dr. Armstrong called attention to the fact that in the earlier days of the Chemical Society much attention had been given to the discussion of the properties of hydrogen, and the view that it possessed metallic properties had been strongly advocated. This was strongly supported by Graham's investigations of hydrogenized palladium, or, hydrogenium, as Graham called it, condensed on palladium. Dr. Armstrong, ventured to think, however, that the subject had been too much regarded from the inorganic side, and that when the evidence to be derived from organic chemistry is taken into account it is more probable that hydrogen will be found to resemble the petroleum hydrocarbons rather than the metals. In reply to a query from Dr. Armstrong, Professor Dewar said that, since Argon solidifies when cooled in liquid air, his experiment with helium shows that the

gas (helium) from the Bath well does not contain argon, and, unless possibly hydrogen is present in small quantity, the helium from the well was pure.

West Oneonta, N. Y.—The West Oneonta and Lawrence Railway Co. has been incorporated by Frank Gould, Parker Wilson, Albert D. Getman, Walter S. Whipple, Harry W. Lee, David S. Peet and R. W. Strong; to build five miles of electric railway between the villages named. Capital stock, \$750,000.

Danbury, Conn.—Messrs. Taylor & Starr may give information concerning construction of electric light plant.

Winnepeg, Man.—No decision has yet been reached regarding the tenders for furnishing an electric light plant. An electrical expert will be engaged to report thereon.

Oshawa, Ont.—The Oshawa Electric Light Company will purchase a 1,500 or 2,000-light alternating dynamo and transformers.

New Market, Va.—A long distance telephone will be put in from Staunton to Eagerstown.

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For Alternating and Direct Current Circuits.

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Write for Circulars and Price Lists 8 and 9.

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JAMES LEFFEL & CO. Springfield, Ohio, U.S.A.

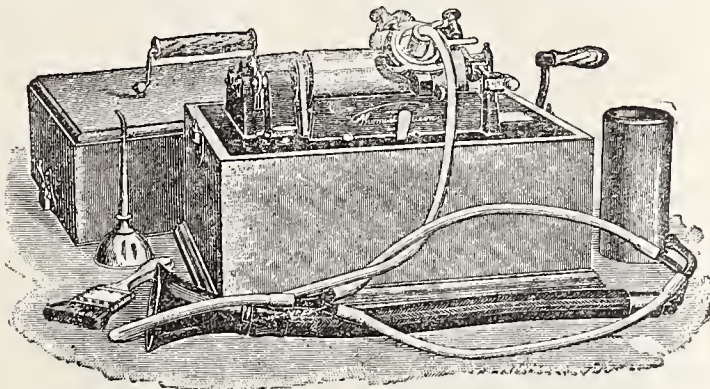
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With Automatic Vacuum Regulator.

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Keeps Vacuum Adjusted Automatically. Can not run too high in Vacuum for Operation. Life practically unlimited.

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With Installation Charge.

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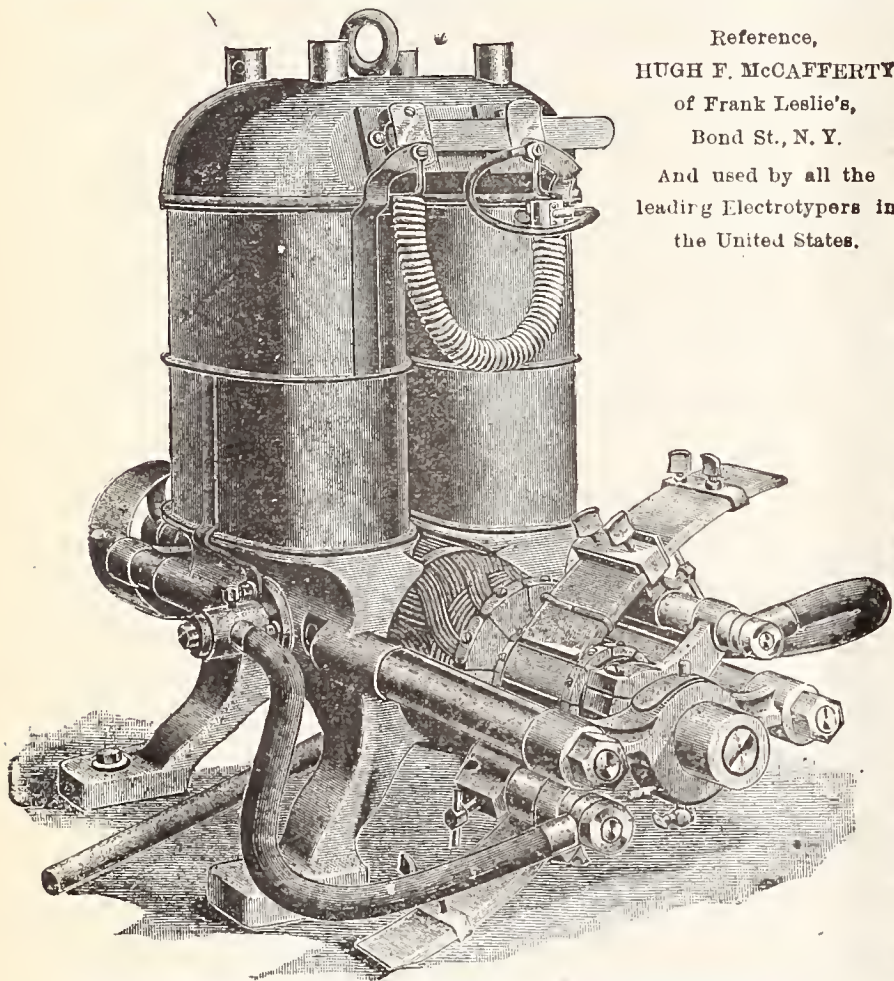
23 LAWRENCE POUNTNEY LANE, LONDON. E. C.

THE WORLD DYNAMO

WILL PRODUCE A SHELL IN 30 MINUTES.

Manufactured by the
ARNOUX & HOCHHAUSEN ELECTRIC CO., 478 & 480 PEARL ST.
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of Frank Leslie's,
Bond St., N. Y.
And used by all the
leading Electrotypers in
the United States.



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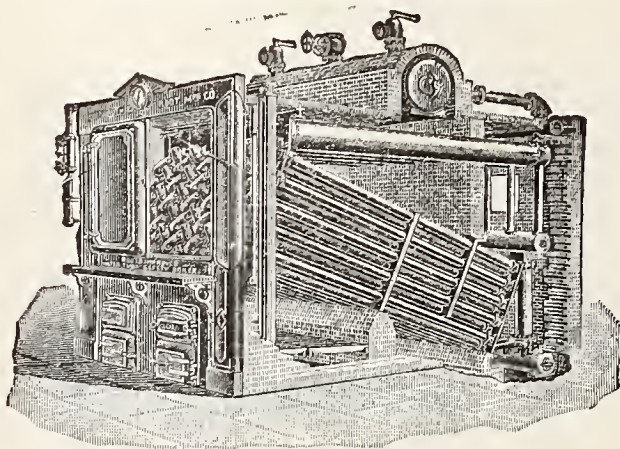
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Examine these Points in the Improved Root Water-Tube Boiler.
Send for our Illustrated Catalogue.

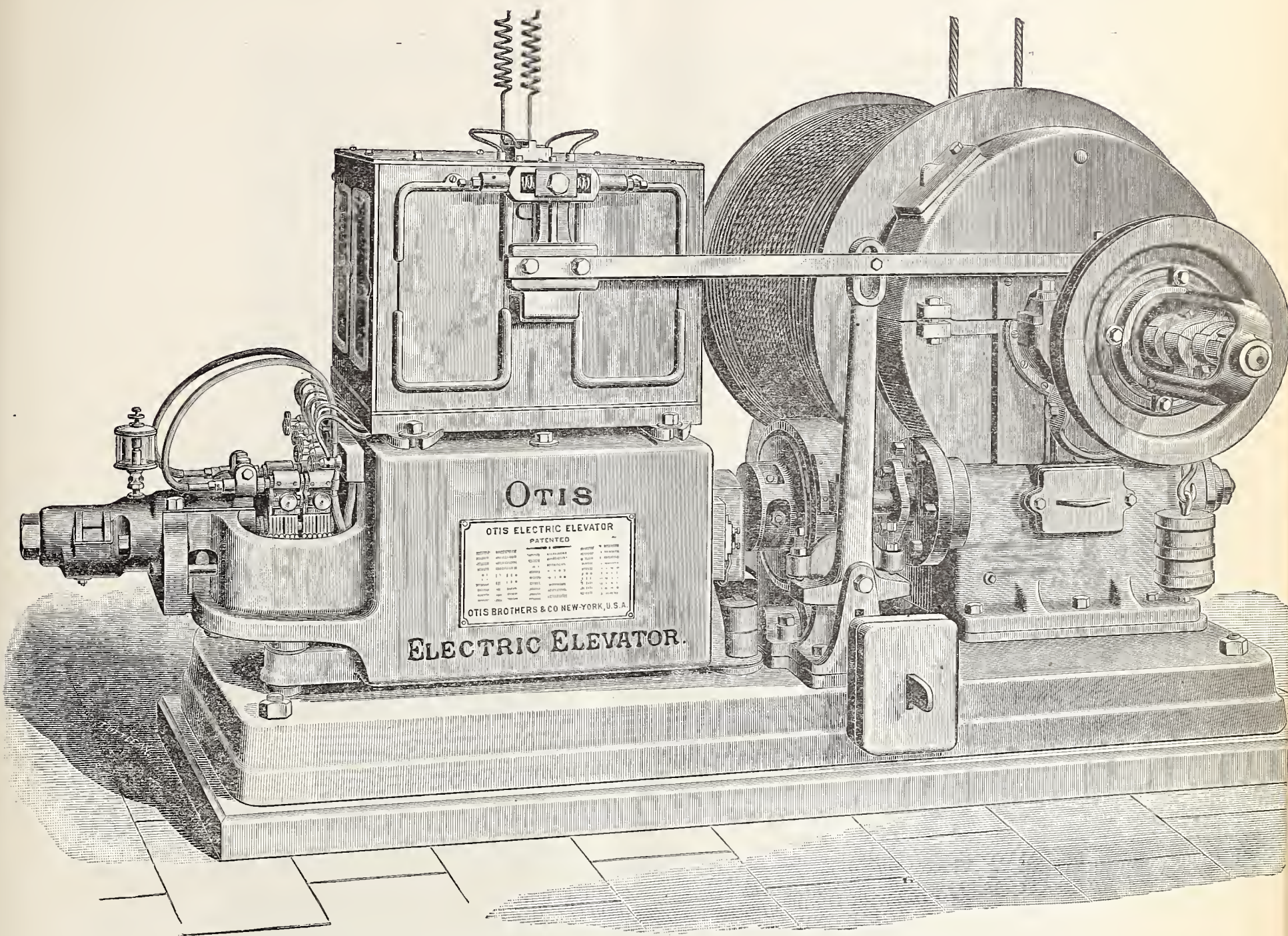
ABENDROTH & ROOT MFG. CO., 28 CLIFF ST.,
NEW YORK CITY.

The Electrical Age.

VOL. XXII—No. 5

NEW YORK, JULY 30, 1898

WHOLE No. 585



Otis Electric Elevator Operated by Improved Push Button Device.

PUSH-BUTTON DEVICE FOR OPERATING ELECTRIC ELEVATORS IN PRIVATE RESIDENCES.

The control of elevators from within the car, as well as their control from without, by means of electric buttons, has added a feature to elevator practice which has been carefully followed out by Otis Brothers & Company, 38 Park Row, New York City, manufacturers of hydraulic, electric, steam and belt elevators. By the Otis improved push-button device the movement of the car is controlled electrically from both car and hallways. Inside the car is placed a set of buttons, each button numbered to correspond to the floor to which it will send the car; by pressing one of these buttons the occupant can send the car to the corresponding floor, the car stopping automatically when it arrives at that floor. A safety-button is placed in the car, by pressing which the passenger can stop the car at any point in its travel. An operating button is placed at each landing, by pressing which the car is brought to any floor from which it is desired to use it.

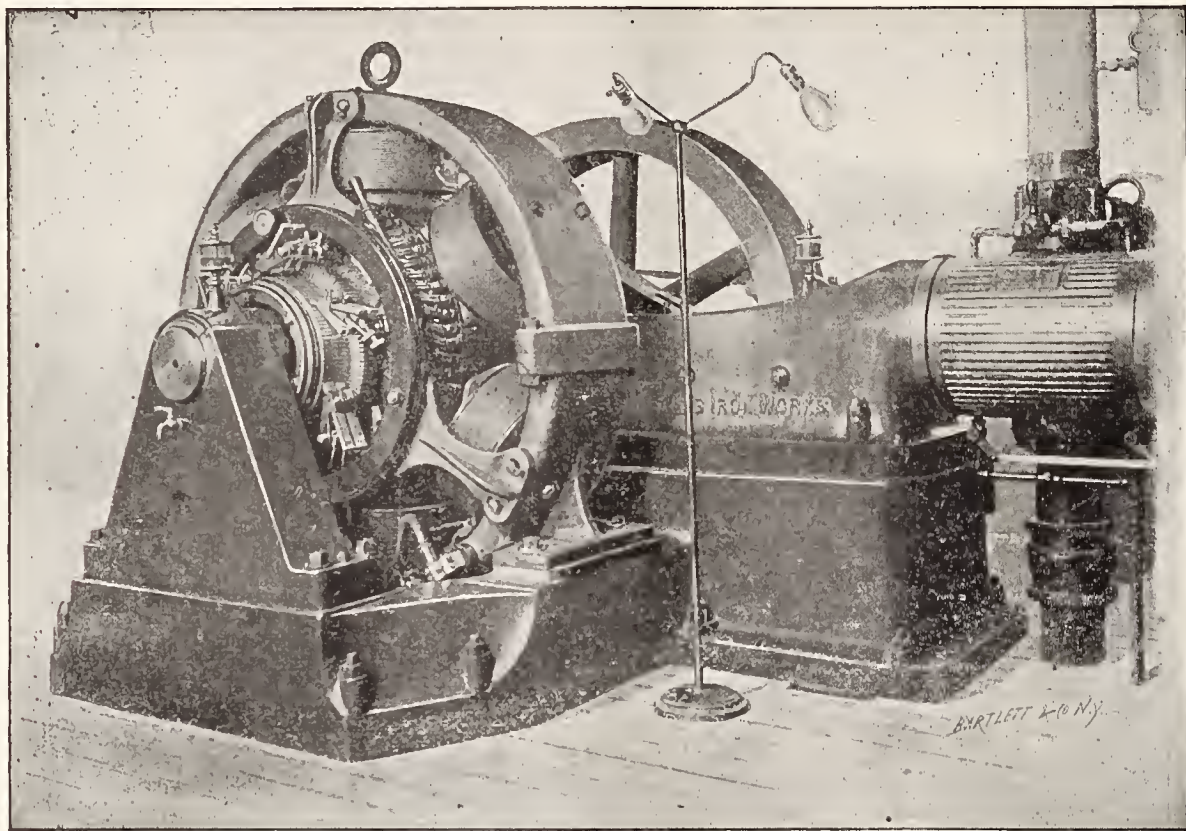
These hall buttons are inoperative when car is in motion; the passenger in the car having absolutely the control of the elevator. The inclosure doors are provided with automatic latches, which prevent the opening of any door unless the car is opposite, and when the door is open the electrical circuit is broken, making all buttons imperative and holding the car immovable at that floor until door is securely closed and button pressed. These safety guards reduce to a minimum the danger usually incident to the use of an elevator in a residence where no provision is made for some one person to be constantly in charge of the elevator. It is very likely that in the course of a few years all private houses of any size will have installed in them elevators of this description, which represent all that is to be desired in that department of electrical engineering.

THE DYNAMO IN THREE IMPORTANT CAPACITIES.

The consequence of any great invention has usually been of such a nature as to cause unwonted activity along those lines it comes in contact with. Reference to

idents in regard to the illumination of their homes, and has enabled municipal authorities to light the streets of large cities so thoroughly that crime has been driven from its hiding place and the slums of large cities rendered safe and pure.

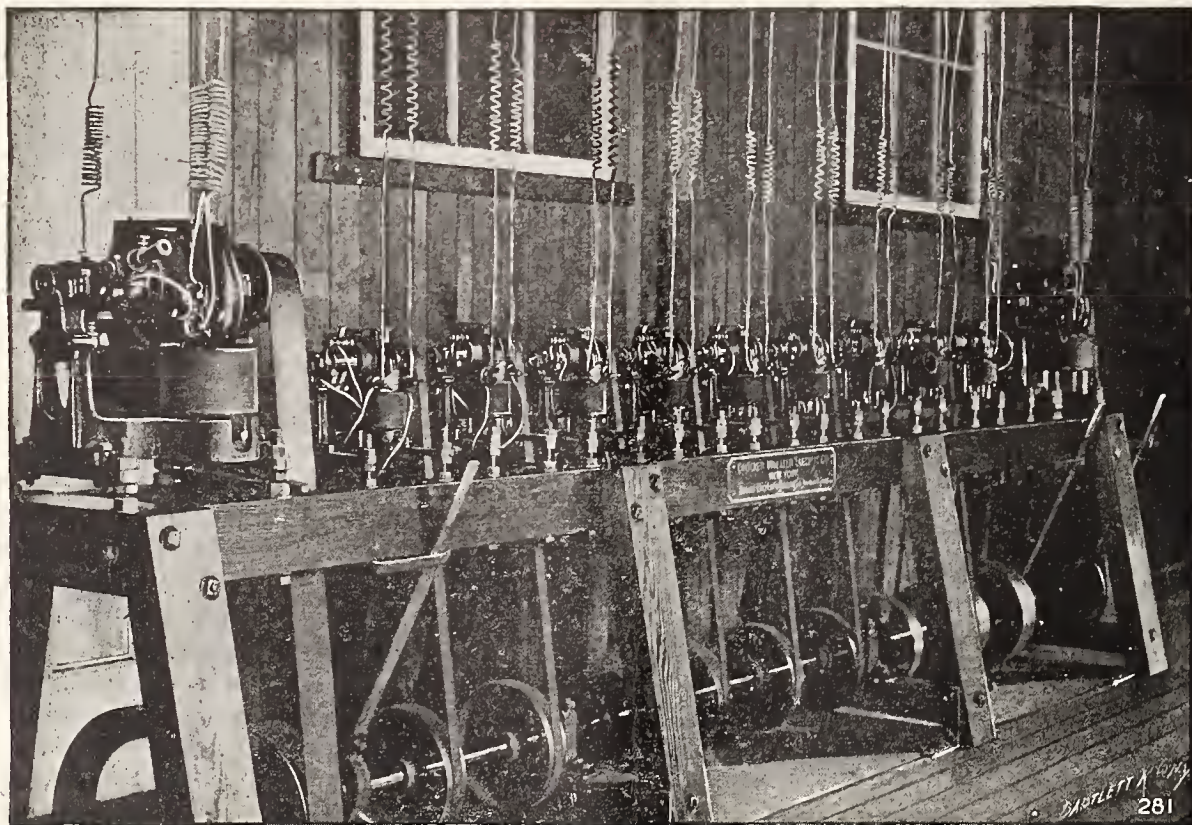
It would be interesting, no doubt, to consider in all its



Size 56 C.-W. Dynamo, direct-connected to shaft of 80 horse-power Ames Engine.
Speed, 275 Revolutions per minute. Capacity, 50 Kilowatts.

past inventions of an older nature will lead the reader to the conclusion that the development of the dynamo in all its branches has not differed materially in its industrial value from the steam engine, sewing machine or gas engine. In some of its applications the dynamo undoubtedly serves a novel purpose. It has solved the

cases the influence of this mere machine upon the progress of civilized races, but the moralist, in his keen search for examples and the causes that lead to goodness or the police station, may perhaps decide with us that the electrician has unconsciously added strength to the efforts made by him and his followers in an ethical direction.



The Old Way. Belt driven. 11 Dynamos. Western Union Telegraph Co., New Haven, Conn., 1892.

problem, so long discussed, of the best method of supplying power to the telegraph lines radiating and combining all over this continent from the Western Union Telegraph Company. It has eased the mind of many suburban res-

The substitution of dynamos of small size for batteries on telegraph lines has proved so successful that in all likelihood they will be extensively employed, with the exception of such small lines as require occasional individ-

ual attention from the country operator. But on long distance lines the dynamo current will be the source of supply, thereby saving the Western Union Telegraph Company thousands of dollars per annum and an immense amount of disagreeable work. For the generation of heavier currents and, in fact, for use in private homes within city limits, gas engine plants are greatly in vogue. Were the size of the gas engine small in proportion to its power, and larger sizes in common use, plants of much greater magnitude would be installed all over the United States.

Where heavier power is required the steam engine is in use, driving dynamos of any size, lighting great towns and running trolley systems miles in extent. It is very likely, however, that the gas engine will keep pace with

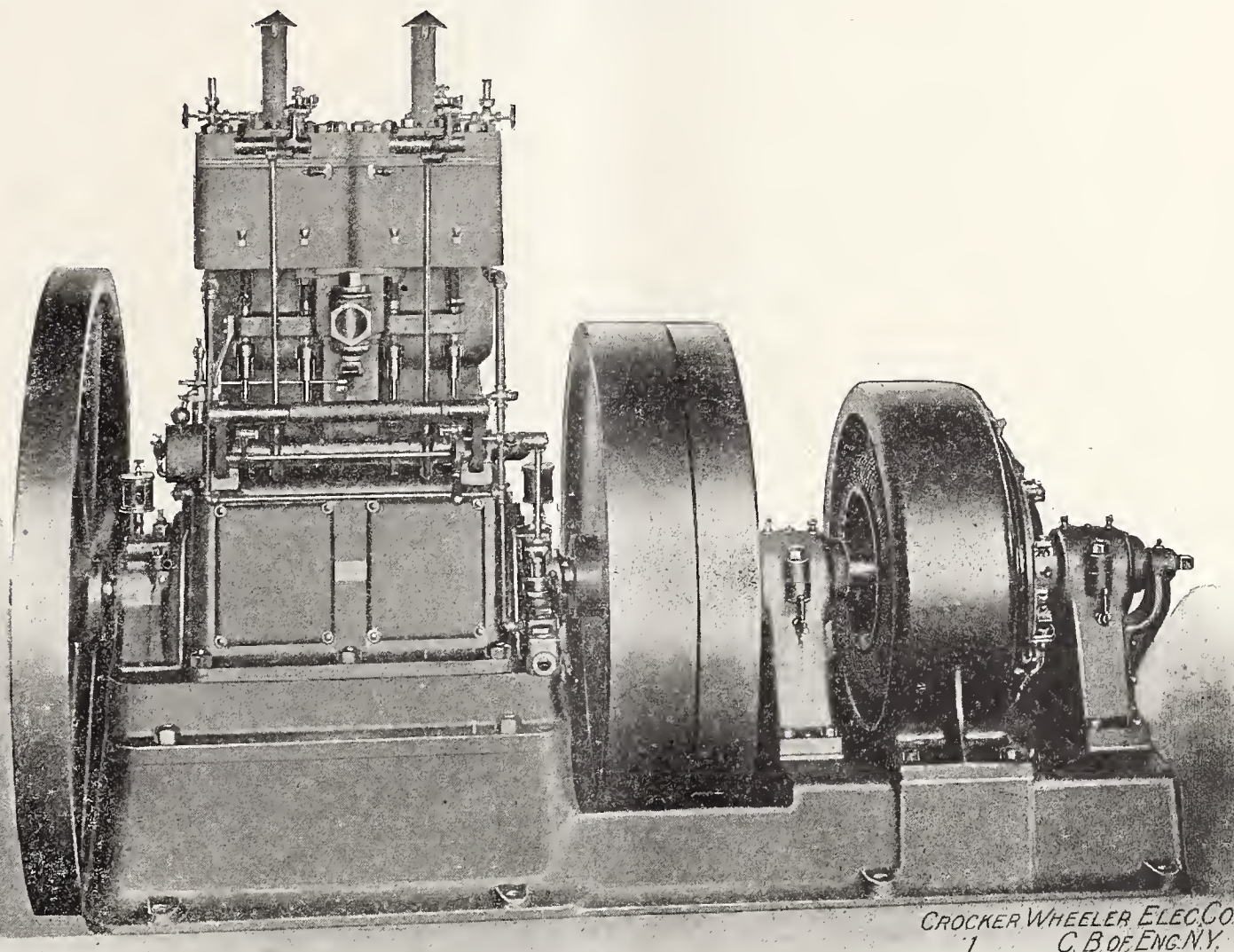
C. Maxwell, M. M. Orlady and A. F. Maxwell. Capital stock, \$50,000.

Ottawa, N. S.—Anglo-French Telegraph Co. has been incorporated to construct a line, by means of a cable and land line, from Vancouver to Dawson City, with extensions.

GROOMING AND CLIPPING BY ELECTRICITY.

The electric motor has become a necessary adjunct to every well-appointed modern stable, whether livery or private, and horses are now groomed and clipped by electricity with both neatness and dispatch.

The advantages of the application of the electric motor



Size 5-100 Dynamo direct-connected to Nash Gas Engine. Crocker-Wheeler Electric Company.

the dynamo for many years to come; its economy of operation and the absence of care required making it in some respects superior to the steam engine, but inferior as far as the generation of great horse power is concerned. Where skilled aid is not at hand the gas engine electric light plant overrides all competition. But at present the gigantic steam plants in operation testify to their popularity among modern American engineers. A gas engine plant with storage batteries is frequently found in villas and country estates, but until its limits are better defined it will not enter into the race as a competitive factor.

Lonaconing, Md.—The Lonaconing & Westernport Passenger Electric Railway Co. will build power plant to operate its railways.

Rush City, Minn.—The Northeastern Telephone Co. has been incorporated by A. J. Stowe, C. F. Jackson, J. D. Markham and S. A. Nebel. Capital stock, \$50,000.

Arlington, S. D.—The Sioux Valley Electric and Telephone Co. has been incorporated by W. J. Maxwell, C.

to grooming and clipping machines were early realized by the American Shearer Manufacturing Company, of Nashua, N. H., and its efforts toward supplying a demand for electrically driven groomers and clippers had met with considerable success. Hitherto, however, it has supplied merely the machinery, exclusive of the motor, but owing to a demand which has arisen for complete grooming and clipping installations, it is now supplying the motor as well. In doing this, however, it has found it necessary to simplify in a large measure the driving mechanism.

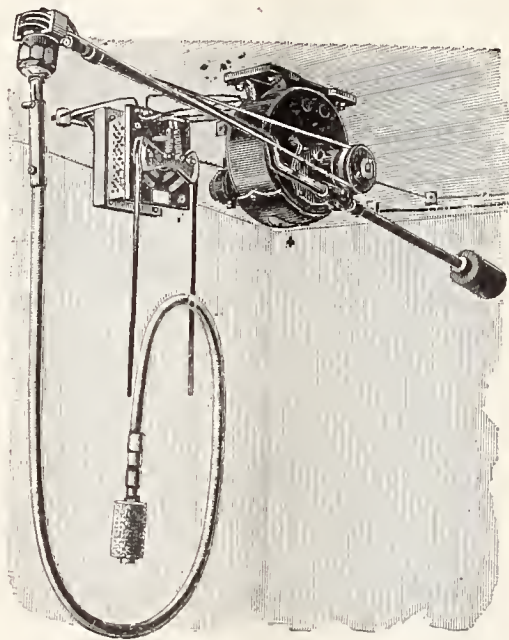
Fig. 1 shows the No. 8 grooming and clipping machine, driven by a bipolar motor through double counter-shafting with conical and idle pulleys. This method, while it allows of the operation of two or more groomers or clippers from one motor, was by no means satisfactory on account of the complication of belts and pulleys necessary, and when it became a question of furnishing both driving and operating machinery, it was felt that some more direct method of drive was needed. This was found in the small power moderate-speed motors developed by the General Electric Company, which in addition to its line of small power induction motors has also recently per-

fecting a line of direct-current small power motors known as the C. A. type. These motors may be run in any position, either attached to the wall, set on a bracket or hung from the ceiling, and have been found peculiarly adapted to drive the groomers and clippers of the American Shearer Manufacturing Company.

Fig. 2 shows the No. 9 machine complete with a one H. P. C. A. motor and automatic starting rheostat. In this case no floor space is occupied by the motor, the countershafting is eliminated, and the belting is reduced

MACHINISTS' AND DRAUGHTMEN'S DATA SHEETS.

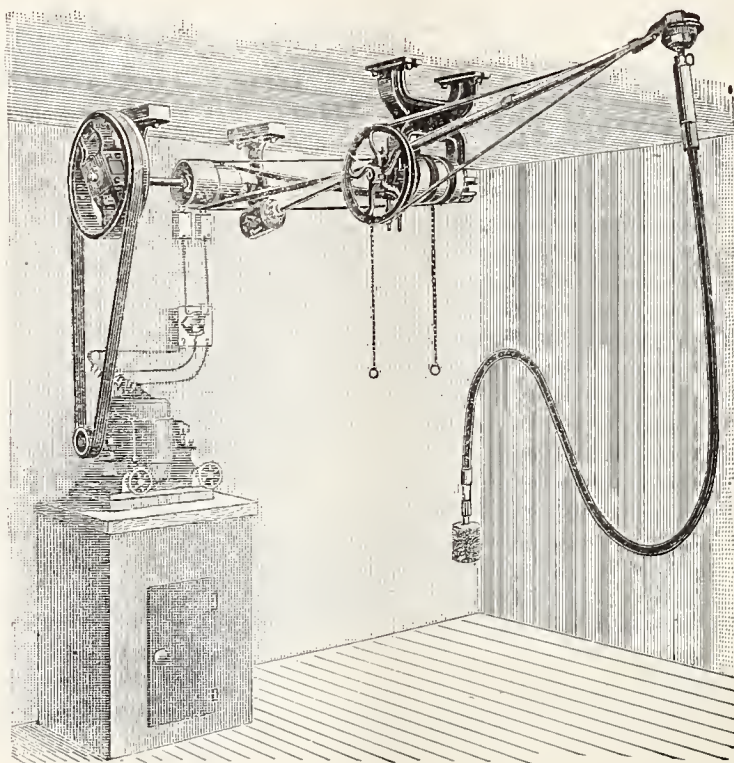
An exceedingly valuable data sheet has been prepared by Georg Kirkegaard, of 28 State street, New York City, to be used by machinists and artisans. On this sheet may be found information relating to the horsepower of belting, the size of drills for machine screw taps, the speed of drills of different diameters, proportions of keys for shafting, speeds of machines and screws, and a



Machine complete with a one-horse-power C.-A. Motor and Automatic Starting Rheostat.

to a single belt from the motor pulley to the pulley attached to the flexible shaft of the groomer and clipper. The motor is fastened to the ceiling beams in an inverted position and the counterpoise, or balance-arm, is attached to a swivel on the motor case. The automatic starting-box, also fastened to the ceiling, is of the reversing type, with the contact arms pulled in either direction by leather straps. This clipping and grooming outfit is singularly

variety of other figures which would save considerable time to those in possession of them. It is hardly necessary to refer to the loss sustained by the proprietors of large factories in the course of a year through five minutes a day being wasted by each employé. In a large factory one hundred employés would in the course of a year, by hunting around for the size of drills and other mechanical dimensions given in this data-sheet, cost the firm about



Old Method of driving Revolving Brush through double counter-shafting.

compact and simple, and requires almost no attention beyond an occasional oiling. In ordering, it is simply necessary to state the nature and voltage of the current, and, if alternating, the phase and number of alternations.

With the electric motor-driven groomer and clipper, a horse may be thoroughly brushed in about $2\frac{1}{2}$ minutes and clipped in about 35 minutes.

\$600.00 per annum. These data-sheets cost fifteen cents apiece and represent one of the best investments the mechanic can make.

Belleville, Ill.—The Madison Telephone Co. has been incorporated by W. H. Johnson, B. L. Behr, E. W. Lazell and T. H. Wright. Capital stock, \$25,000.

SOME PHASES OF THE RAPID TRANSIT PROBLEM.

(Concluded.)

A second modification occurs in the necessity of having stations placed on a level track, and since a train has an appreciable length it must travel its own length before the last car is off the level and the full effect of the grade is felt. Thus, during the first period of acceleration the rate is comparatively small and must be furnished by the motors, resulting in a material reduction in the energy gain in the theoretically ideal profile. An artificial profile can only be secured on elevated or underground roads, and a double-track road necessitates two separate overhead structures, and the underground road must consist of two separate tunnels with unlike profiles.

Assuming two stations to be on the same level, there are two forms of profile that may be assumed with a given maximum difference in levels, as shown in Fig. 6. Profile A consists of a down-grade with a level track at each terminus equal to the length of train operating over the road, while profile B consists of a down-grade and up-grade equal in length and percentage with a level track connecting them, and also a level track at each station equal to a train length.

In practice a perfectly symmetrical profile, as in B, will not be possible, as the level track connecting grades must be replaced by a slight grade to provide for drainage in tunnel roads, this grade preferably opposing the direction of movement of the train.

In order to ascertain the behavior of a train upon the two forms of profiles and to determine the most efficient form of grade, a series of curves have been plotted upon the following assumptions:

Length of run total, 2,000 ft.

Train friction, 15 lbs. per ton constant.

Braking effort, 150 lbs. per ton during time brakes are set.

Running time, 75 seconds.

Length of train, 200 ft., corresponding to an average train of four to five cars.

Tractive effort, as supplied by motors, 100 lbs. per ton. (This effort being supplied irrespective of added effort due to grades.)

No running is assumed to take place on the motor curve, and train is supposed to coast after reaching maximum speed. Motors are controlled by the ordinary series-parallel method, starting with two motors in series and throwing them into multiple, the starting resistance being supposed to be cut out uniformly so that 100 lbs. per ton motor effort is maintained constant while current is on.

Due regard is paid to the fact that the tractive effort due to grade depends upon the proportional length of train off the level track at the stations, and hence is a constantly increasing quantity until the entire train is on grade.

A grade of 4 per cent. has been chosen for the down-grade in A, and for both down and up-grades in B; and energy consumption plotted in Fig. 6 for different lengths of grade.

Thus, for a run of 2,000 ft. in 75 seconds the energy input with series-parallel control is 40.75 watt hours per ton for a level track, which is reduced to 27.8 watt hours in curve A with a length of 500 ft., 4 per cent. grade and 32.6 watt hours per ton in B, with the same length of 4 per cent. grade; that is, with the same vertical fall.

A length of 500 ft. of 4 per cent. grade calls for a vertical fall of 20 ft., which is not excessive in practice; hence, by the use of a profile similar to B, Fig. 6, the energy consumption for a given run may be reduced as much as 40 to 50 per cent. from that required on a level track.

With proper proportioning of the gear ratio of the motor, allowing some acceleration on the motor curve,

this saving in energy consumption could even be exceeded, so that a rapid transit road, especially a tunnel road, properly laid out with an artificial profile, could operate with a very much less energy consumption than an existing surface road.

THE DEVELOPMENT OF THE CENTRAL STATION.

AN ADDRESS DELIVERED AT PURDUE UNIVERSITY, LAFAYETTE, IND., MAY 17, 1898,
BY SAMUEL INSULL.

Mr. President and Gentlemen:

When requested a short time ago by the chief of the Electrical Department of this University to deliver a lecture on some subject connected with central station work, I must confess to having had some misgivings in accepting the honor to appear before you this evening, remembering the disadvantages that a commercial man invariably feels in discussing technical matters before those having had technical training, but then I remembered that even within my own time (and I think I can still claim to be a young man) very little was known of the general distribution of electrical energy from a central station, and when I recalled that so recently as the early 80's it was necessarily the rule for "guessing to be a substitute for mathematics" (to use the words of the great pioneer in central station work), my misgivings were inclined to disappear, and I felt encouraged to talk to you on the development of the central station from the point of view of my own experience in following this, the latest of the great industrial developments of the wonderful era in which we live.

In referring to the development of the central station, it would seem hardly necessary to go at length into the history of the business, the origin of which probably dates from the work of the early experimenters whose efforts were directed to the perfection of series arc lighting. Whilst their work is entitled to the greatest possible praise, it should be remembered that the theory on which they worked, namely, constant current and varying potential, is a theory foredoomed to failure, when applied to the development of a system of general distribution for light and power purposes, the first essential of which is the necessity for a constant potential, the quantity of current varying in accordance with the demands made by those desiring to use the energy, whether for light or power purposes. Nor does it seem to me a matter very pertinent to the present occasion to trace the rival claims as to priority of invention of the early experimenters on incandescent lamps. Which of them was the first to produce a lamp that could be brought to a state of incandescence by means of the electric current is hardly within the scope of our inquiry. Probably all of them, groping in the dark (now and then illumined by the flashes of light emitted from their experimental glow lamps), contributed in a more or less degree to the perfection of the incandescent lamp as now in every-day use; but so far as their contributing much that is substantial, in the development of a system of central station distribution, it is probable that, up to the year 1880, there was but one man who realized that in solving the great problem of electrical distribution the perfection of a filament of high resistance, which placed in a hermetically sealed glass globe from which the air had been exhausted and connected in multiple arc across an electric circuit, was the first necessity to the distribution of electric energy in our cities from a central station system.

In Mr. Edison's application for a United States patent on a system of electrical distribution filed at Washington on February 5, 1880, he says:

"The translating devices for each house may be either for light or power, or both. For light, the electric lamp, consisting of an incandescing material hermetically sealed in glass (shown in other applications made by me) is preferred. This lamp is made of a high resistance in comparison with that of any electric lamps which, to my knowledge, have been proposed. In lights heretofore proposed the endeavor seems to have been to lessen the resistance of the carbon, none having been suggested of higher resistance than, say, 10 ohms; but I have discovered that a very much higher resistance, say 100 ohms, must be used, in order that a number may be economically and successfully used in a system."

The question of the high resistance of the translating device was the first stepping-stone to success. Everybody prior to Edison had aimed at getting a low resistance lamp, I presume, on the theory that the less the resistance of one the less the resistance of the whole series. He struck out on new lines. A high resistance lamp was naturally followed by the multiple arc system.

In writing of the necessity of a high resistance lamp, the applicant for the patent had in mind that a system of electrical distribution could be used at the same time not only for lighting, but for power purposes, if the motors were properly constructed, and this is evidenced by the next paragraph in his application, which states:

"The motors should be so constructed that each, with a constant flow or pressure of current, will give the exact power required. This requires that each motor should be wound with finer or coarser wire, and into more or less convolutions, which determine the maximum effect of the motor."

If you will search the files of the daily and technical journals, and the proceedings of various scientific societies on both sides of the Atlantic from the summer of 1878 up to and including the year 1882, you will find that the great obstacles in the way of an economical system of central station distribution were the difficulties of producing a lamp that would last, one requiring only a minimum of current, and a system of electrical distribution requiring a minimum of capital, so as to enable electricity to compete with then existing methods of illumination and power. Prof. Henry Morton, on December 28, 1879, says in the New York "Times."

"The first difficulty of all is the production of a lamp which shall be thoroughly reliable, and neither complicated nor expensive. All attempts up to the present lamp in this direction are acknowledged to be failures, and, as I have pointed out, there does not seem to be any novelty such as would authorize us to hope for better success than the present one. The next difficulty is the economical production of small lights by electricity. This is what is commonly meant by the phrase, 'dividing the electric light.' Up to the present time, and including Mr. Edison's latest experiments, it appears that this involves an immense loss of efficiency.

"Next comes the difficulty of distributing on any large scale the immense electric current which would be needed, and to provide for their equal action at different points under varying conditions of the number of lights used."

Again, Mr. Conrad Cooke, giving evidence before the British Parliamentary Commission in 1879, in answer to the question: "Supposing that the occupier of one house wished to put out his lights, how would this be effected?" replied:

"In that case, if you throw out a lamp or throw out a house, you must throw into the circuit a resistance exactly equal to what you cut out. If you do not do that, you will affect every lamp in the series and the machine as well. If you put out your lights by breaking the circuit, you put out every light in the series."

In answer to another question at the same Parliamentary inquiry, Mr. Cooke said (referring to Dr. Siemens, who had been named in the question):

"His nephew told me himself that he had seen, I think, over 200 lamps on one of Edison's circuits."

And Mr. Cooke added:

"I must say I should like to see it myself, and that is all I can say."

It is quite evident from this that Conrad Cooke, very well known in England as a prolific writer on the subject of electrical experiments, had in mind, in 1879, nothing better than the series system, that is, a number of incandescent lamps run precisely the same as arc lamps, or, to put it another way, his idea of the electric lighting system was a varying potential and a constant current, which could never be run on a large scale successfully. Sir William Thomson (Lord Kelvin), referring to the same Parliamentary inquiry of 1879, says:

"I had not myself, at that time, any idea leading toward the practical realization of any such distribution of conductors and placing the lights as outlined in the Edison multiple arc and feeder system."

Evidently Mr. Swan, the English inventor, had no idea of the feeder system as late as October, 1880, as in a lecture before the Literary and Philosophical Society of Newcastle, England, at that time, he said:

"The only way of avoiding this waste of energy, without abandoning the idea of small units of light, would be either to employ enormously thick conductors, or have a very limited area supplied from one source."

Mr. Swan was referring to Mr. Edison's plain multiple arc system, as set forth in his application of February, 1880. The last eight words of this quotation prove that Mr. Swan did not then know of Mr. Edison's feeder system, application for patent on which was made on the 9th of August, 1880, and was patented in England on the 24th of September of the same year. It would seem that even in 1882 Mr. Swan, who himself at that time must have been informed as to Mr. Edison's invention of the feeder system, could not have appreciated the possibilities of such a system, as, in a paper communicated to the British Association at Southampton in August of that year, he stated:

"The only escape from that limitation (extent of distribution) lay in having secondary batteries at stations or in houses, and in these batteries being connected in series and fed by currents of higher tension, the principle still holding of multiple arc, not from the central station, but from the subsidiary ones from which the batteries are charged. Once imagine the possibility of these secondary batteries being kept at a perfectly constant condition of charge by some automatic arrangement, and we might look to that as a means of escaping from the difficulties of wide distribution."

Again we find that Dr. C. W. Siemens, before the Society of Arts in London, on the 15th of November, 1882, said that he thought:

"It would be possible to establish electrical mains in the shape of copper rods of great thickness, with branches diverging from them in all directions, though he was himself decidedly averse to such a plan. He said he would limit the area of the densely populated district to one-quarter of a square mile, notwithstanding other individuals of high standing in electrical circles held that areas of from one to four square miles could be worked to advantage."

Dr. Siemens went on to say:

"In considering the proper size of conductors, two principal factors have to be taken into account: First, the charge for interest and depreciation on the original cost of a unit length of the conductor, and, secondly, the cost of the electrical energy lost through the resistance of a unit of length. The sum of these two, which may be regarded as the cost of the conveyance of electricity, is clearly least, as Sir William Thomson pointed out some time ago, when the two components are equal. This, then, is the principle on which the size of a conductor should be determined."

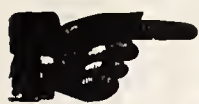
(To be continued.)

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THE STEAM TURBINE.

The possible use of the steam turbine in lieu of the steam engine has brought it most prominently before the engineering public. In a contemporary of ours we notice that the Hon. Charles A. Parsons has petitioned the English government for an extension of time upon his patent, which was granted on the twenty-third of April, 1884. The efforts of other inventors to create the type of machine he has made a success of failed, and as Mr. Parsons has shown that the invention may have a great influence upon the engineering art in England and other countries, it is likely that five years will be added to the life of his patent, although it seems as though the actual reasons would not be stated until a later day.

We quote from the "Indian Textile Journal," evidence was given as to the great merit of the invention. Machines made in accordance with the invention were being largely adopted and were being bought all over the country. One of the machines had been fitted to a vessel one hundred feet long, which attained a speed of thirty-four and one-half knots—a speed which, it was believed, would be increased if the machines were fitted to larger vessels. Lord Kelvin was called as a witness in support of the petition and said there was no practical steam turbine before Mr. Parsons'. Mr. Parsons' invention gave for the first time a practical steam turbine. There was a great future for the steam turbine. The petitioner's invention had given very good results, and for many purposes it was going to supersede the reciprocating engine; its application to ships being a great step forward. The Privy Council received the petition of Mr. Parsons, considered it favorably, and "Lord Watson said their lordships would humbly recommend Her Majesty to grant an extension of the patent for a term of five years, and they would state their reasons for coming to that conclusion at a later day." It is very likely that Mr. Parsons' plea will be met with favor, and if so in the next few years we

may expect marked improvements in the art of using steam for power without the aid of reciprocating parts. All great inventions have in certain respects affected the progress of their originators, and the world's eye has been slowly opened to the fact that its greatest future is dependent upon the efforts of such men as Parsons and Edison of today, as Fulton, Watt and Ericsson of the past. It is in some respects a crime to deny an inventor an extension of time when the invention appears in so glorious a light, with its untold possibilities, as this creation of Mr. Parsons' brain.

Our contemporary further states that "the sympathy of inventors and of the public generally will go with the inventor, who, if his petition is accepted, as it probably will be, may look forward to a period of pecuniary success which has been honestly earned."

MARINE DISASTERS PREVENTED BY THE USE OF ELECTRICAL APPLIANCES.

The steel ship has become in the eyes of many critics a huge coffin ready to sink at any moment into the ocean's depths. The safety of a steamship's passengers depends entirely upon the number of air chambers a vessel possesses and the speed and precision with which they can be closed in a moment of danger; otherwise the great steel shell when struck amidship is like a can with a bottom knocked out, or any other contrivance solely dependent upon its displacement for flotative power, and not upon the inherent buoyancy of the material of which it is constructed. Watertight compartments are practically paid for by the passenger crossing the ocean. They are supposed to render the ship unsinkable, and to rest the minds of those on board at night when dangers come crowding in from the darkness.

At the last accident which happened to the unfortunate "Bourgogne" a general paralysis of action seemed to prevail, leading subsequently to the frightful scenes that followed. But in large transatlantic steamers, upon which money has been lavishly spent in order to obtain the best that science can give, devices should be installed which would instantly close air chambers and open wide all points of exit to those on board.

Few of the passengers on an ocean voyage realize that but a half inch of steel separates them from a watery abyss miles in depth. A fuller realization of this fact would lead them to make demands upon steamship companies before taking passage, thus forcing them to adopt means for the preservation of their lives that would be ready and reliable. It is only when such awful catastrophes thrill mankind with horror that attention is directed to such features of marine construction which become most prominent by their apparent absence.

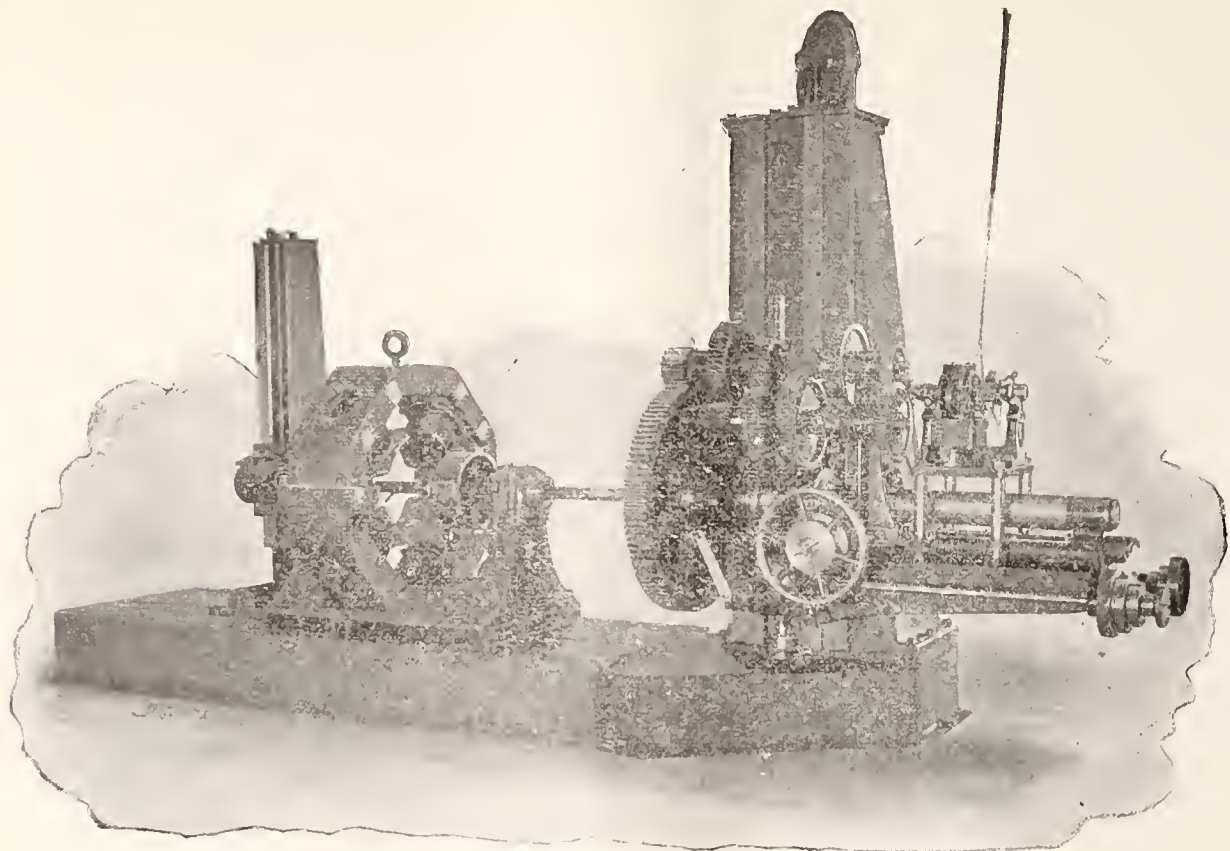
The use of electrical machinery to close doors leading to air chambers should be enforced and a board of commissioners instituted to make a series of tests with the same for the determination of their efficiency, safety, etc. These experiments should be performed before another boat load goes down, for "an ounce of prevention is worth a pound of cure."

The traveller entering Birmingham after nightfall is greeted by a lurid glow in the distance which soon resolves itself into long rows of columns of flame from one of the great centres of that industry which has served to give it the name of the "Iron City" of the South; for, situated as it is in a valley surrounded by coal and iron mines, as well as immense deposits of limestone, this city is exceptionally capable of producing and, by means of its many lines of railroads, placing in the market large quantities of iron and steel, as well as the manufactured product of these materials.

Birmingham proper is a town of some 70,000 inhabit-

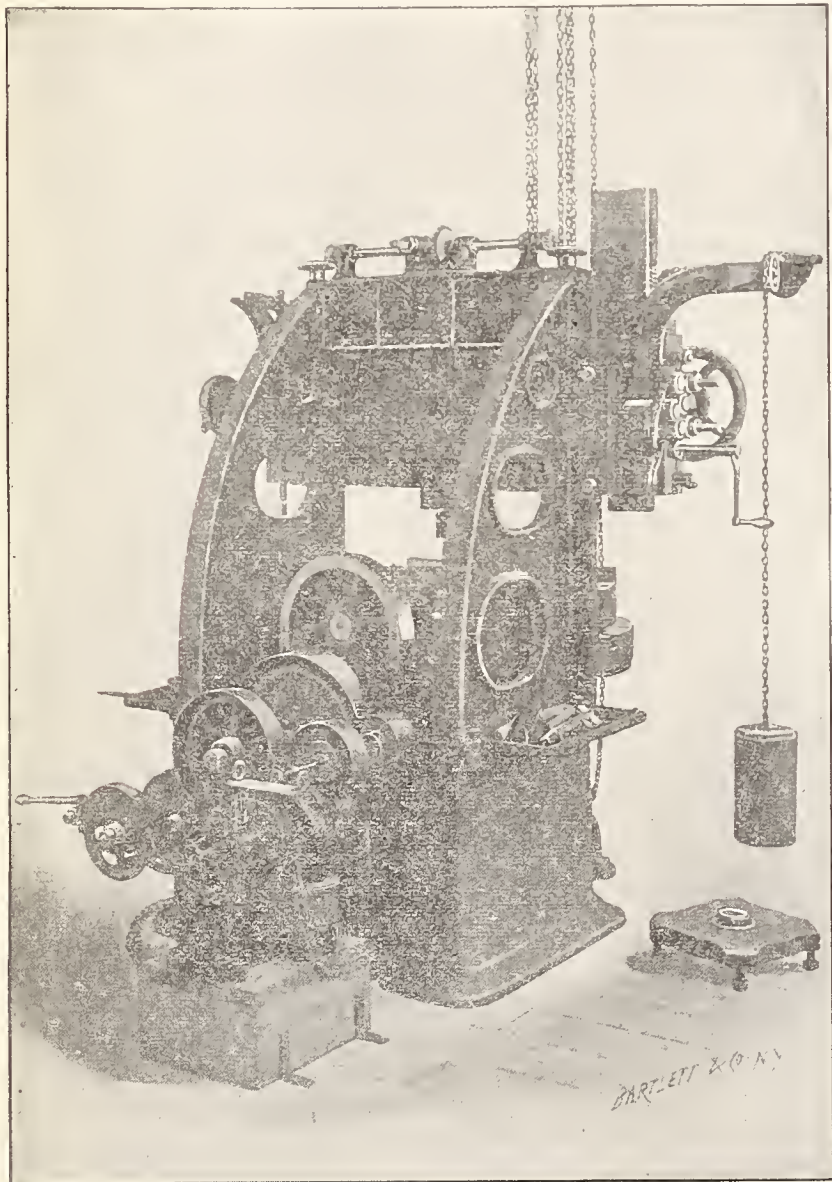
ants; its suburbs cover many miles of the surrounding country, which is everywhere dotted with centres of the iron industry.

\$600,000, a cotton-seed oil mill, and two large ice plants. The former method of street car transportation by steam is being superseded by electric traction, several

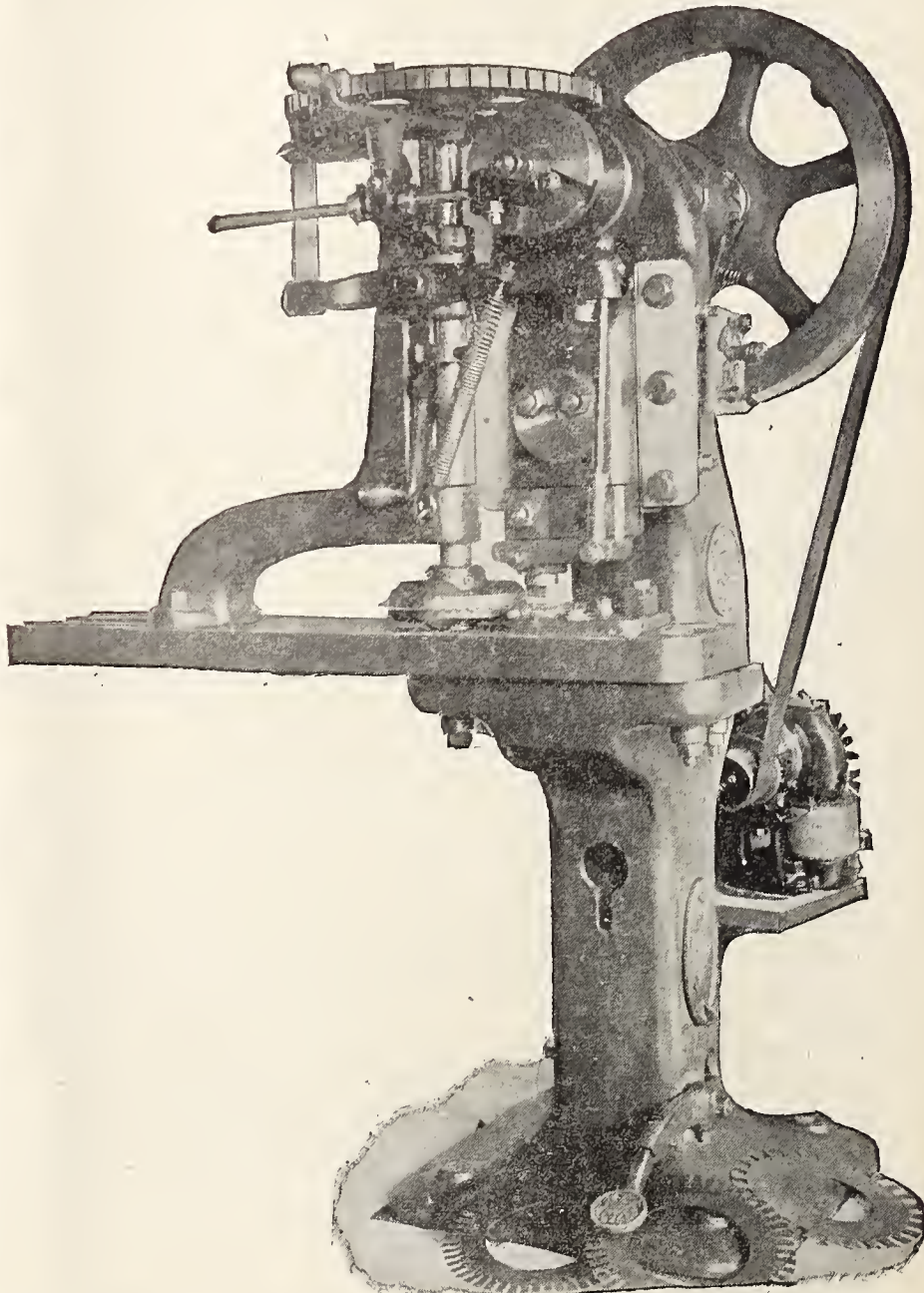


Size 1 C. W. Motor Built on Boring Head and Supplying Power to 10-ton Boring Mill. Speed Changes Obtained by Nest of Gears.

Principal among these are the Shloss and Alice furnaces and the East Lake rolling mill. There are also a



Size 2 Motor, Geared to Vertical Boring Mill. Speed Changes by Nest of Gears.



1-2 Motor Belted to Ferracute Notching Press.

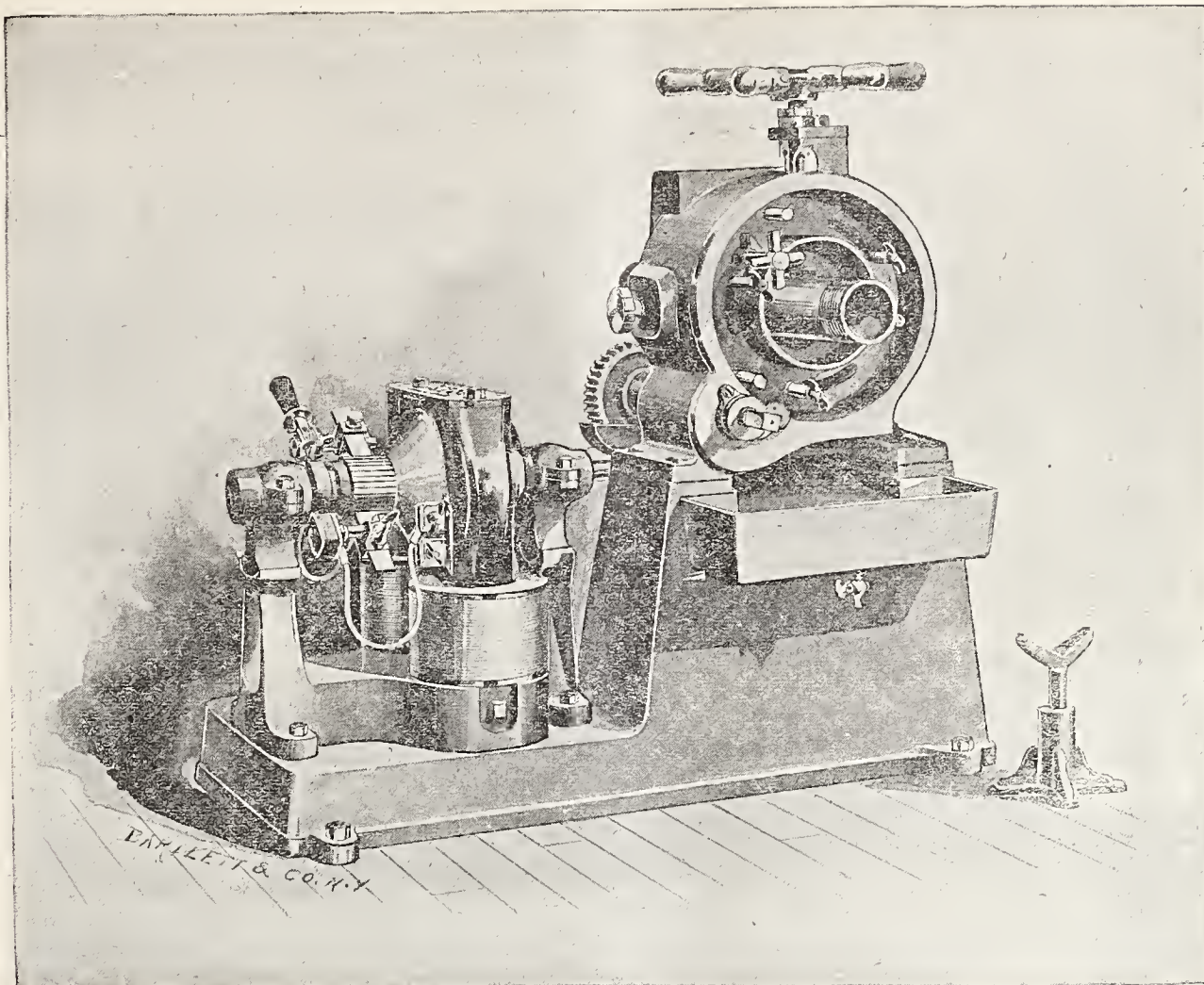
number of immense machine and boiler shops, as well as the Avondale Cotton Mill, recently completed at a cost of

lines being in operation. We had the pleasure of participating in the inaugural trip and inspection of the Bir-

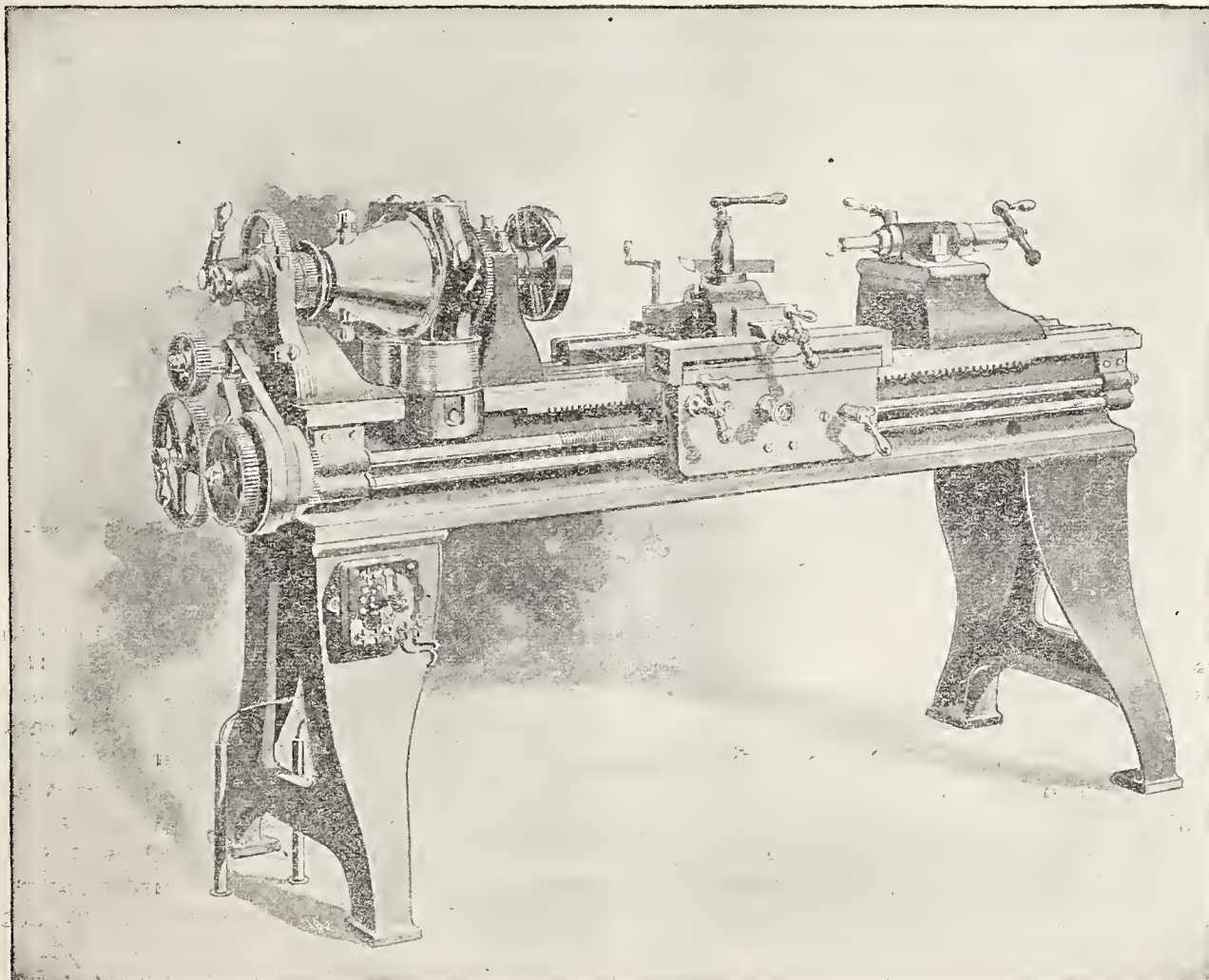
irmingham Traction Co. This road runs through the suburbs a distance of six miles; has a well ballasted road-bed. The cars are probably the finest in this section, well

and two Corliss type engines; they as well as the boilers were built in Birmingham.

The Consolidated Electric Light and Power Co. has a



Motor Combined with Pipe-Threading Machine.



Electric Lathe Design.

finished, equipped with General Electric apparatus, signals from inside the car, vestibules, etc. Their station equipment consists of two 150 K. W., G. E. generators

power house covering nearly a city block. They have three large belted engines and have just installed a high speed connected engine, which is, however, not yet in

operation; their maximum load is now 2,200 H. P., and is constantly increasing. All of the boilers, piping, and the 150-ft. stack, are home products. Nearly all of the hardest manual labor here is done by the negroes, the height of their ambition being to become firemen in some one of the numerous plants.

THE MACHINE SHOP OF THE TWENTIETH CENTURY.

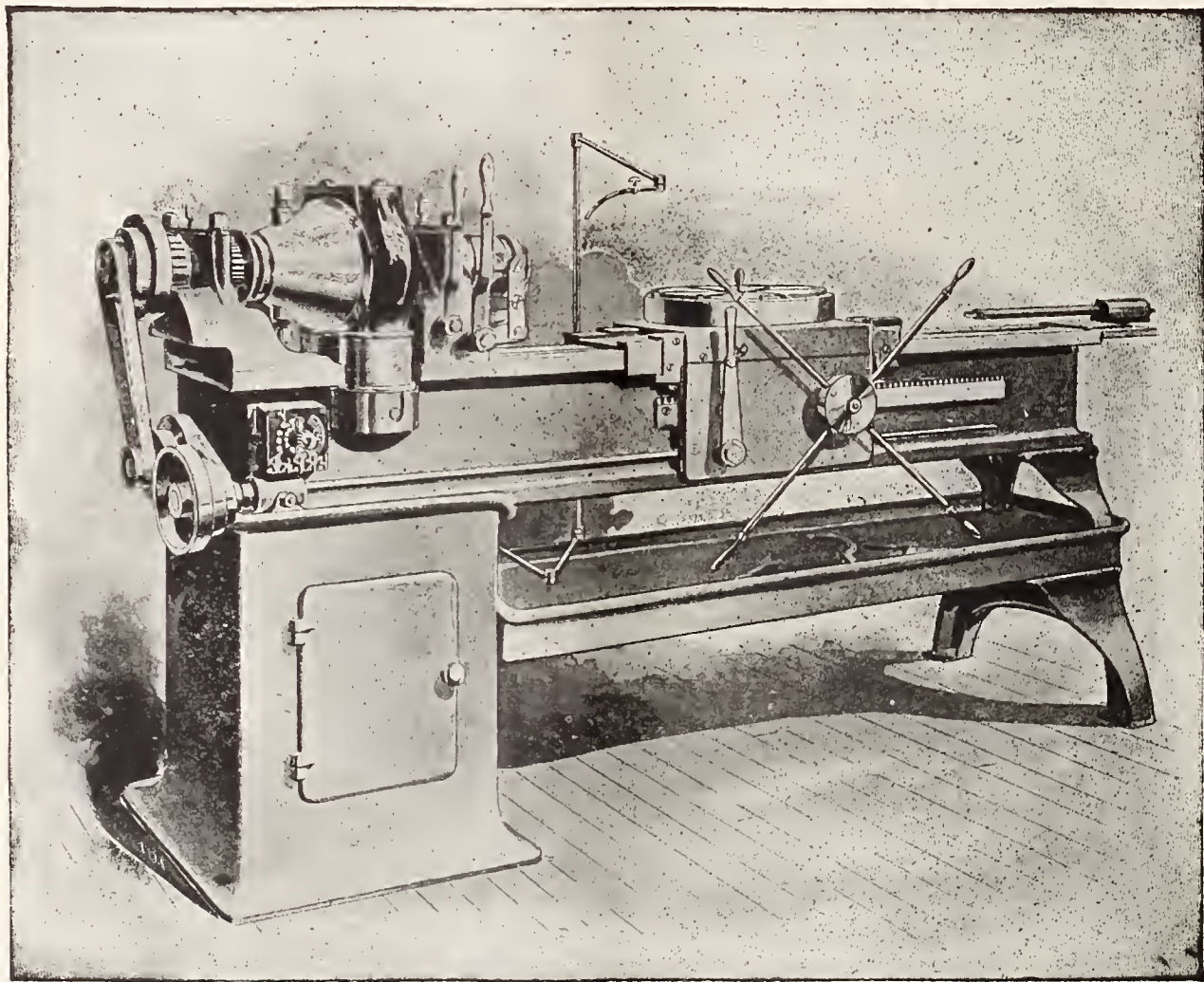
To prophesy in these times does not mean immortality to the prophet. Judging from the trend of modern progress, it is a matter of simple judgment to forecast the future with almost unerring accuracy. In the respect of using motors on machine tools this prophecy cannot fail to meet with approbation from all interested in the advance and practical development of the electrical science. The authority on power transmission pronounces in its favor, and the manufacturer of such machinery believes that in the practice of this principle certain benefits are gained in the shop which are in their nature inherently beneficial. The proprietor himself can be readily made

connected machines are not necessary. But in the majority of cases where such conditions do not prevail, and this leakage is continually occurring, direct-connected machines equipped as those seen in the illustrations will transform an ancient and wasteful plant into a modern and economically-run establishment.

The details of such saving and sufficient evidence to prove that it is not at all chimerical can be obtained from the Crocker-Wheeler Electric Co., of Ampere, N. J.

A NEW FORM OF POTENTIAL REGULATOR.

One of the great obstacles with which the series system of incandescent lighting has had to contend has been its want of flexibility. If the circuit is laid out for the full number of lamps which the normal voltage will operate, a means must be provided for increasing the voltage to take care of additional lamps ordinarily called for for a short time. On the other hand, if only a part of the possible number of lamps are connected in circuit, expensive or complicated arrangements are necessary to absorb the surplus voltage.



Electric Monitor Design.

to conclude that such an installation means an actual saving of dollars and cents at the end of a term of years, which is, naturally enough, to him at least, the best argument in its favor.

The entire problem of attaching motors direct to machines must be considered in this manner. What does it cost to install a plant of this kind? How much money is saved per annum by the saving of power which is needlessly wasted in a belt-driven factory? The absence of countershafts, pulleys, etc., removes an element of danger and a source of constant loss from a shop, which from the earliest days of machine-shop practice have existed. In transmitting power by belt from 30 to 60 per cent. may be wasted, according to our best authorities on this subject. In very large factories, where the machines are in constant use and the source of power is near enough to the shop or shops to prevent this waste, direct-

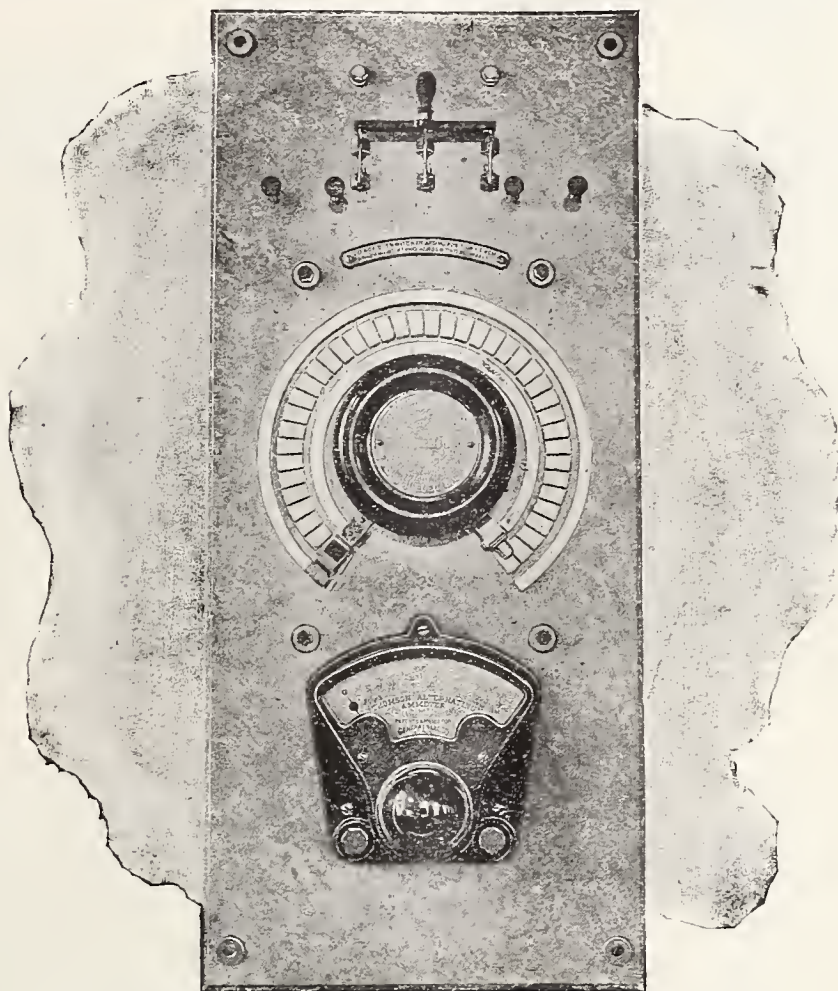
To regulate the voltage the following methods are used:

Extra lamps are installed at the station and cut in or out of circuit as required. This method is expensive, as the power consumed in the lamps is totally lost, and the lamps are worn out while their light is wasted.

Reactive coils are placed in series with the circuit at the station. This method is also expensive, because the electromotive force of the coil is out of phase with the voltage of the circuit, and, consequently, the voltage produced within the coil will be much more than the actual reduction in the voltage of the circuit.

Reactance or shunt coils are used in connection with each lamp in the circuit. Such coils can only produce approximate compensation for the lamps that may be extinguished and are not satisfactory for compensation for the lamps permanently out of circuit, for the same reason that reactive coils are not satisfactory.

For satisfactorily controlling the voltage, the General Electric Co. has developed a form of potential regulator especially adapted for this work, by the use of which the series system becomes almost as flexible as a parallel system and the power consumed in the circuit varies directly in proportion to the number of lamps in use. A regulator panel, with ammeter, switch and fuses, is shown in the illustration. The regulator is mounted on the back of the panel, and consists of a compensator, from the secondary winding of which taps are connected to a set of contact blocks arranged in circular form on the front of the board. A hand wheel in the centre of the ring of contacts operates two arms carrying brushes which connect from the contact blocks to continuous rings on the inside and outside of the contact blocks. One of these arms is connected directly to the hand wheel; the other is connected through a bevel gear, so that the direction of rotation of one arm corresponds to that of the hand wheel, while the other moves in the opposite direction.



A Potential Regulator for Series Incandescent Lighting.

The compensator is so connected that whatever difference of voltage exists between the two concrete rings on the dial switch is added to or subtracted from the initial voltage of the circuit. If one arm be directly over the other, there is no difference of potential between these rings. If the hand wheel be turned to the left, a gradually increasing voltage, which will be added to that of the line, will be developed between the rings, while a gradually decreasing voltage, which will be subtracted from the initial voltage, will be developed if the hand wheel be turned to the right. The ammeter below the hand wheel indicates the current in the circuit. When the number of lamps in circuit is changed, it is simply necessary to turn the hand wheel until the proper current is indicated.

The compensators are wound for the standard currents of 3, 5, and 5.5 amperes, and in either case will increase or decrease the initial voltage of 1,150 or 2,300 by 230 volts. Special regulators giving a greater range of voltage will be built, if desired.

"ELECTRO-DYNAMICS," published by Longmans, Green & Company, has for its author Charles Ashley Carus-Wilson, professor of electrical engineering at McGill University, Montreal. The book is practically a treat-

ment of the direct-current motor, considered from a purely scientific standpoint. By this is meant not a complete adherence to the purely scientific side of the question, but a consideration of those principles upon which the construction and design of all direct-current motors should be based, with further elucidation of them by reference to practical examples. In this respect the book is unique and in many senses complete. It appeals to the student of electro-technics as much as to the practical mind, and in the scope of its treatment includes information relating to the efficiency, winding and design of motors which will be approved of by the highest critics and students in the electrical profession.

NEW ELECTRICAL INCORPORATIONS AND BUSINESS CHANGES.

Manhattan, N. Y.—Peekskill Traction Co. has been incorporated by Charles Mason, M. D., James H. Haight,

Frank Frye, Charles N. Wells, Jay R. Decatur, Matthew Clune, James F. Martin, Hanford Smith and Jacob Larsch. Capital stock, \$150,000.

Columbus, Ohio.—The New Harrison Telephone Co. has been incorporated by Geo. W. Hull, H. T. Hull, L. C. Cunningham, D. W. Morris and John P. Manton. Capital stock, \$100,000.

RAILWAY MOTORS AND CONTROLLERS.

LESSON LEAVES

FOR

THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The use of motors for track service is limited to those of the series type. A series motor possesses advantages over the shunt that both experience and theory advocate. The current flowing through a series motor passes from brush to brush via armature and field. The speed and pull of the armature can be changed at will by varying the pressure applied to the armature and its current and field.

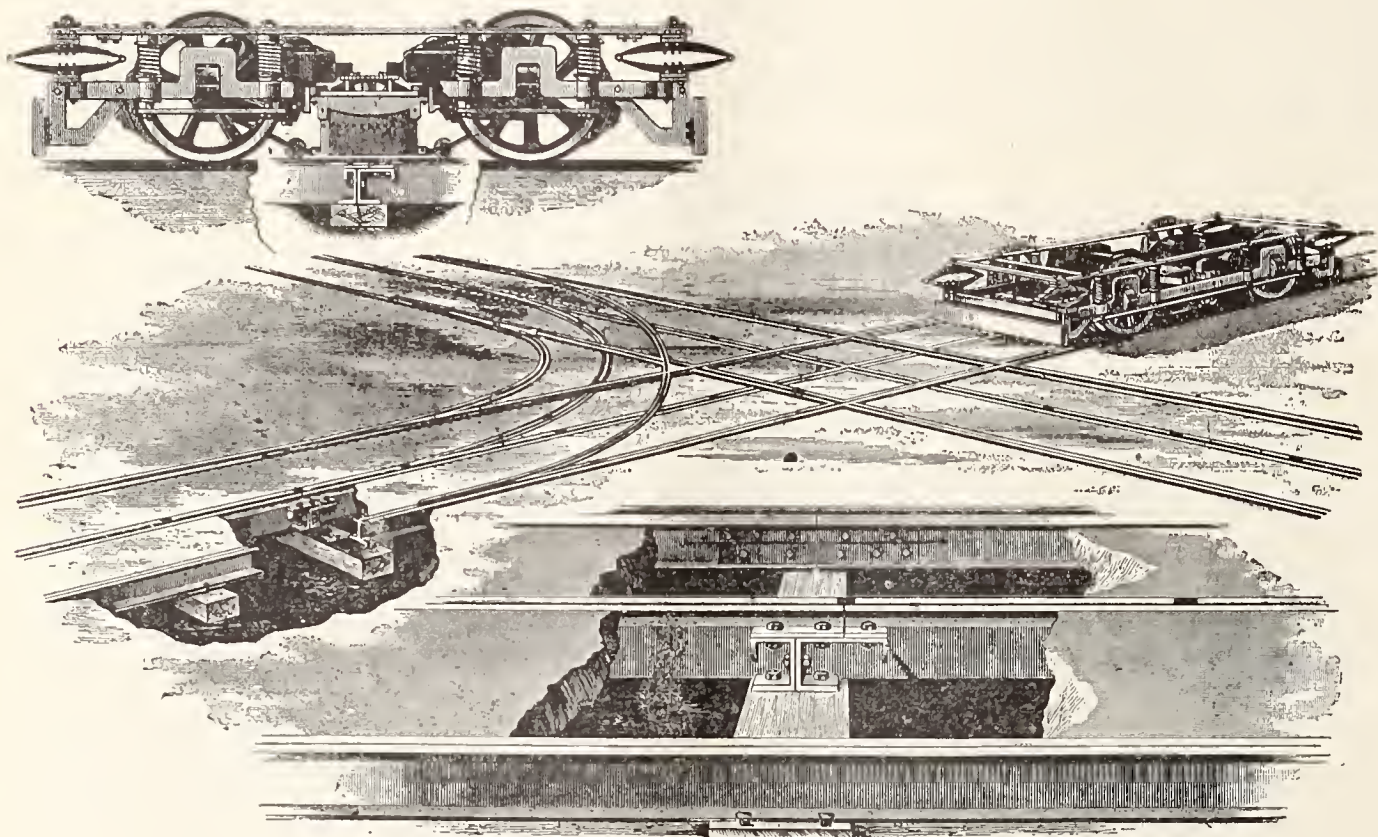
The pulling power of any armature depends upon the

- (1) Current in the armature.
- (2) Strength of field.

The series motor is naturally adapted by its construction to an easy system of regulation. Not only can the current be varied outside by having a rheostat in series with the motor, but the magnet coils can likewise act in this capacity by being subdivided. A series motor connected to a rheostat and having commutated or subdivided field coils can be regulated both in speed and power by these means.

A trolley car is usually equipped with two motors.

more level road. The reason for this is traced to the greater strain upon the motors when climbing hills. The work the motor performs is divisible into two parts—that of advancing and that of lifting itself the height of the hill. In certain localities it seems evident that a cable system would be best; that is, a very hilly district. Block electric, open conduit and storage battery systems are occasionally heard of. In New York City, perhaps, the conduit system is receiving the best trial of all. Several of our largest railroads are about to permanently adopt electric cars for special purposes; the B. & O. being the most prominent of all.



McLaughlin's Conduit System.

They are both series motors with commutated field coils. A small rheostat is in series with the pair. To vary the speed and pull of the car an automatic switching device called a controller is used.

Function of a Controller.—When the car is at rest the rheostat and both motors are in series. To start the car and put it through its different speeds, the controller, which consists of a cylindrical vertical commutator, is revolved. The general result is as follows:

- (1) The rheostat and two motors in series.
- (2) The two motors thrown in multiple.
- (3) Subdivided fields thrown into multiple.

To each of these general processes there are subdivisions; that is, the rheostat contains steps which regulate to some extent—the motors may be thrown in multiple, or their fields and armatures separately, and in addition different combinations may be made of the commutated fields. The practical result of all these changes is to increase the current flowing through the motors by successive stages until the pressure and current is at a maximum.

The heaviness of motor cars has necessitated the use of strong steel rails and a secure bond. The cars used are not very different from the old horse-car style, except that they are better furnished, more capacious and in every respect more comfortable. Both station, track, car and motors are a source of expense to the company. The station has machinery which depreciates; the track requires many repairs unless well put down, and even then the rails wear out; the motors have armatures which constantly burn out and the cars become scratched and shabby from daily use.

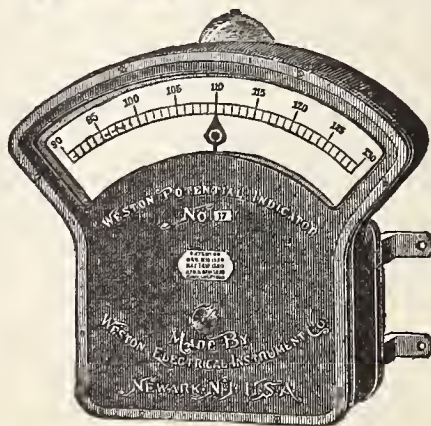
Trolley lines running over hilly ground are apt to incur more expense from repairs than those installed on

QUESTIONS FOR REVIEW.

- (1) What type of motor is used for track service?
- (2) How is the pulling power of the armature governed?
- (3) Describe the equipment of a trolley car?
- (4) What is a controller?
- (5) What general arrangement of circuits takes place?
- (6) When is cable or electricity best adapted to the locality?

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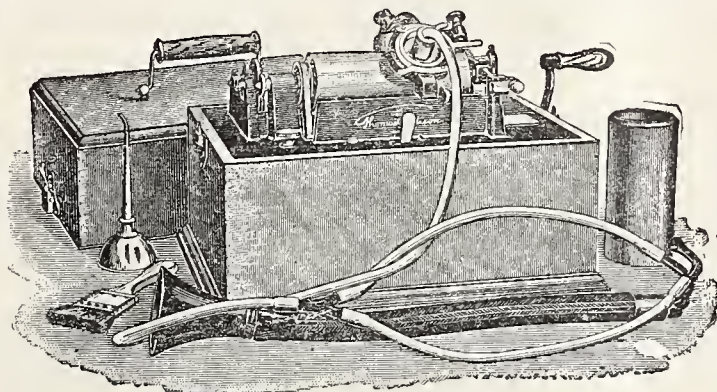
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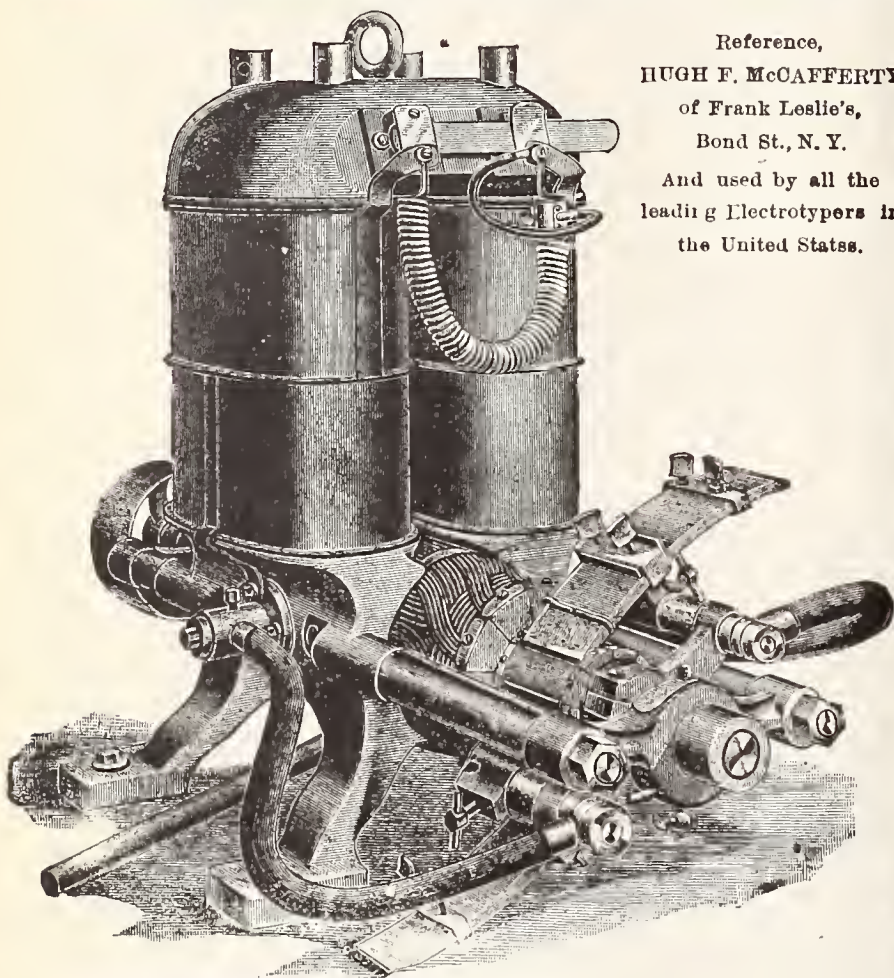
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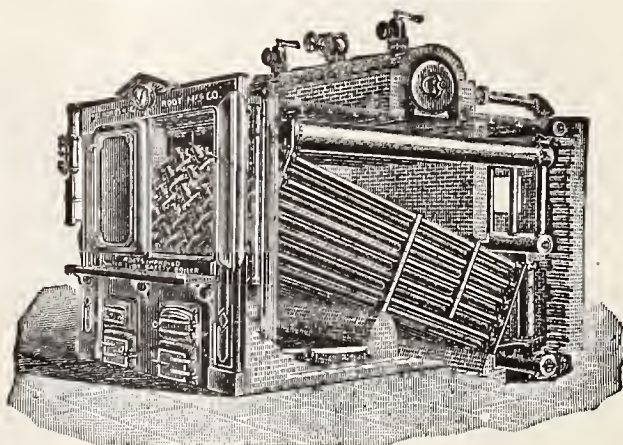
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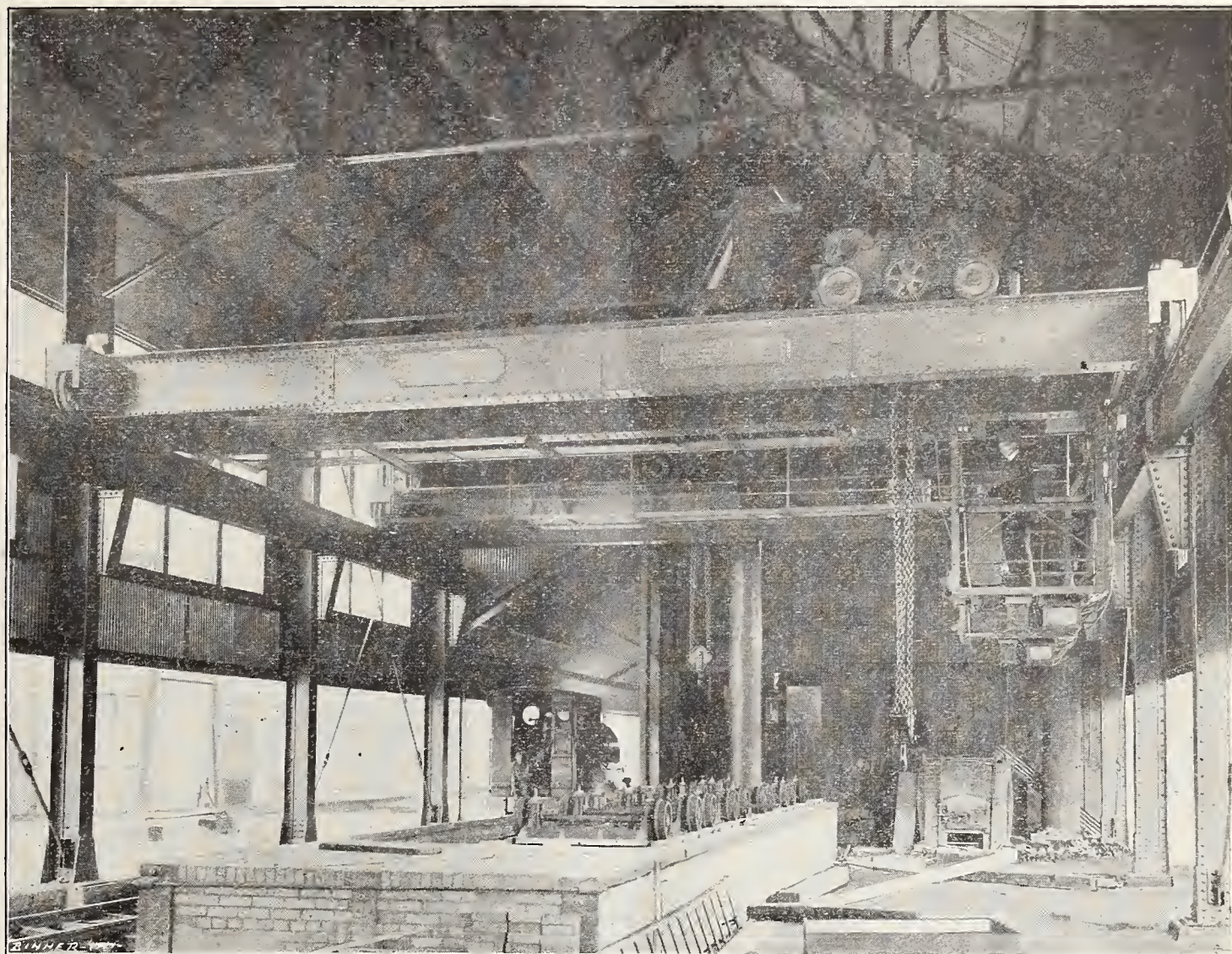
ABENDROTH & ROOT MFG. CO., 28 CLIFF ST.,
NEW YORK CITY.

The Electrical Age.

VOL. XXII—No. 6

NEW YORK, AUGUST 6, 1898

WHOLE No. 586



Electric Travelling Crane built by the Case Manufacturing Co. of Columbus, O., installed in Laughlin's Works at Martins Ferry, O

ELECTRIC TRAVELLING CRANES OF THIRTY THOUSAND POUNDS CAPACITY.

The construction of heavy machinery has had its influence upon the world's progress in more ways than one. In large factories and manufacturing plants the transportation of heavy weights from point to point involves the use of some sort of crane substantially built and capable of withstanding a strain of many tons. Manufacturers have discovered in the course of their experience that frequently the profits of the concern they pilot through the channels of trade depend largely upon the time saved in handling the material placed upon the market. It is therefore evident to them as well as the general public that all time-saving devices, and machinery built to facilitate internal operations in factories represent an investment which is constantly paying dividends to the investor.

The electric travelling cranes built by the Case Manufacturing Company, of Columbus, O., illustrated in these columns represent a type of machinery which in every respect answers to the above description from an economical and commercial standpoint. Two large electric cranes having a capacity respectively of twenty thousand and thirty thousand pounds have been installed in the works of the Laughlin concern, at Martin's Ferry, O.

From a technical standpoint these cranes have fully

satisfied the purchasers. They represent a combination of strength, efficiency, and comparative lightness which give them a superior position in the eyes of the engineering fraternity. The motors operating these cranes are covered up from all possible contact with dust or dirt and their overload capacity is very great.

Cranes have been tested to twice their rated load without perceptible vibration or injury to the motor. This percentage of overload without detriment to the machine shows a design and construction of the highest order, and is entirely due to the science, care and skill exercised in their actual construction. The main girders and end-truck frames are so solidly connected that the girders could not possibly interfere with the operation of the wheel base by getting out of line.

Among other points of interest in the construction of this crane may be noticed the mechanism utilized for the purpose of lifting a given load. It is impossible for the weight to react by reversal, because it operates automatically in securing itself at any given point. A magnetic brake adjusted to the hoisting mechanism interferes with the continued action of the motor after the switch has been turned off, bringing it to a state of absolute rest.

In order that the operator may give the bridge the care

and attention it requires, the motor giving it movement is placed in this crane above the operator, or at least above the stand from which he controls the entire crane. The position of the operator is a most convenient one with reference to the crane and bridge-moving motor. His cage is large and conveniently arranged, so as to allow of ample freedom in controlling the speed and operating other devices controlled from his stand. The bridge is so built that the operator may walk along its entire length without inconvenience and pay particular attention to every part of the mechanism. The operator's switch-board has been carefully designed in every detail, and represents a most practical and convenient arrangement of wires and switches.

The mechanical details that enter into the construction of the hoisting gear are as follows: the hoisting gear itself is composed of two drums, each drum grooved spirally with a chain winding around it from each end

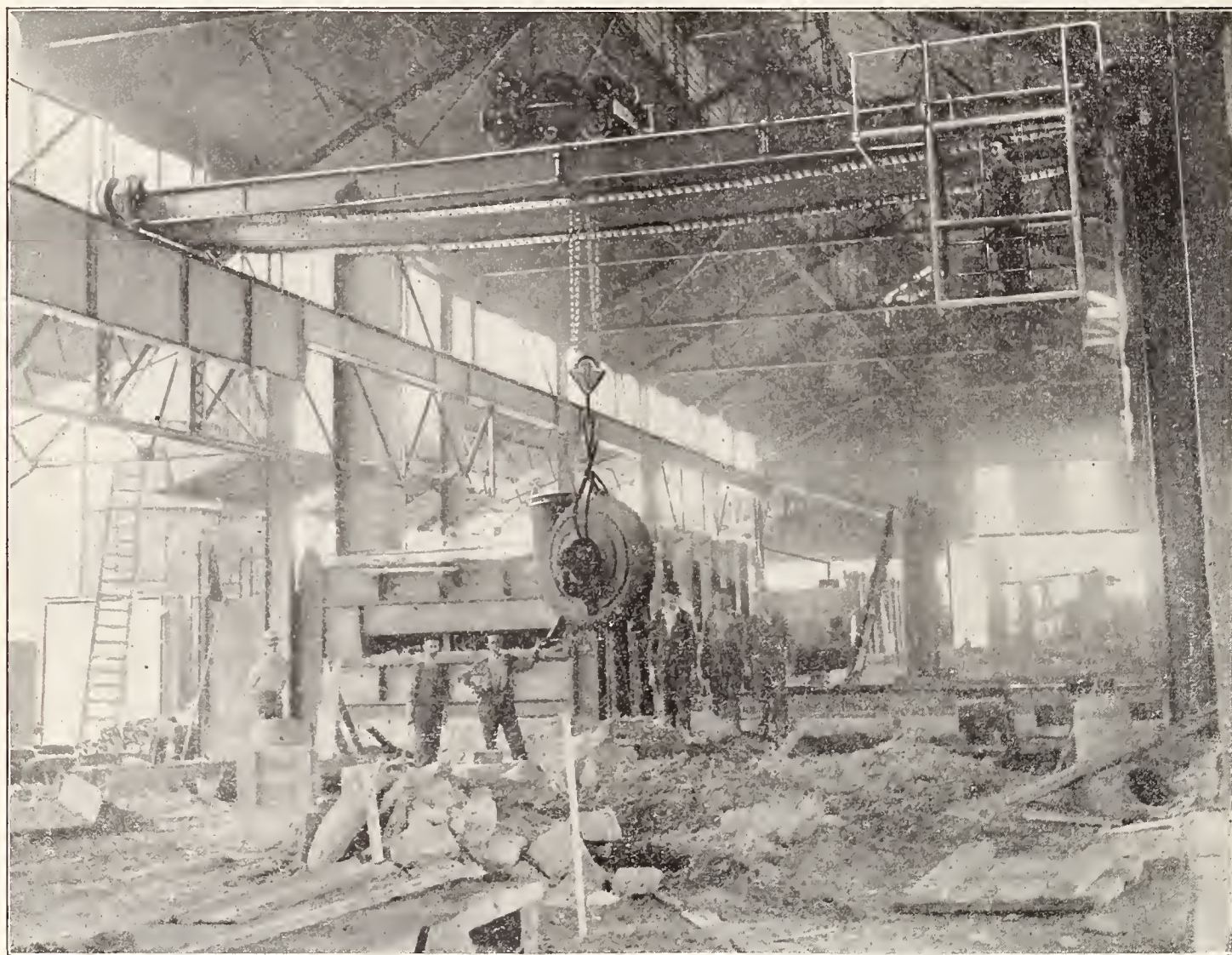
proportions used in lieu of deficient, uneconomical and old-fashioned mechanical contrivances that have lived through their period of usefulness and been relegated with hosts of similar relatives to the scrap heap.

An era of change is at hand which will bring material advantages to those concerns gifted with enough foresight to anticipate the demands of the next century and with sense enough to develop a trade in those things most beneficial to the arts and applied sciences of that period.

THE EFFECT OF HEAT ON INSULATING MATERIALS.

BY PUTNAM A. BATES AND WALTER C. BARNES.

A paper on this subject was presented before the American Institute of Electrical Engineers on May 20,



Electric Travelling Cranes of the Case Mfg. Co.

to the middle. A great advantage of this construction is due to the fact that in raising or lowering the load the chains on each drum are inclined towards each other an equal number of degrees, thereby preventing any torsion of the block.

It is hardly necessary to add in conclusion that many parts of these cranes are interchangeable, the removal of parts can be made with the utmost facility and dispatch; the strength and quality of the steel, bronze, etc., used is of the highest and best. The ready application of these cranes to the work of large shops is such that we can safely predict their universal use in the course of a few years.

The Case Manufacturing Company have succeeded so well in the construction and installation of electric cranes that some of the largest concerns in the country now regard them as authorities in the theory and practice of electric crane construction. Let another ten years sweep us within the limits of the twentieth century and we will find electrical apparatus of the most gigantic

1896,* by Messrs. Sever, Monell and Perry. In the discussion which followed, the results were questioned by several members, and Mr. C. F. Scott cited some investigations of Mr. Skinner, who obtained curves which differed very considerably from those shown in the paper.†

This left the subject in such an unsatisfactory condition that it was decided to make further tests with the object of reconciling the differences or determining what the real facts are.

In our investigations, more attention has been paid to the actions which take place when one kind of material is subjected to tests while the conditions are varied, rather than a great number of tests on different materials under the same conditions.

In fact, it has been deemed wise to conduct all the tests on one kind of material, it being safe to conclude from results previously obtained, that the action on it

* Transactions, vol. xiii, page 223.

† Ibid, page 237.

would be quite similar to that produced on other samples. Therefore the ordinary "red fibre" insulating material having the general appearance of thick red paper, has

having a radiating surface of 47 square inches. This is nothing more than six resistance coils tightly packed with asbestos in a short sheet iron cylinder, whose lower

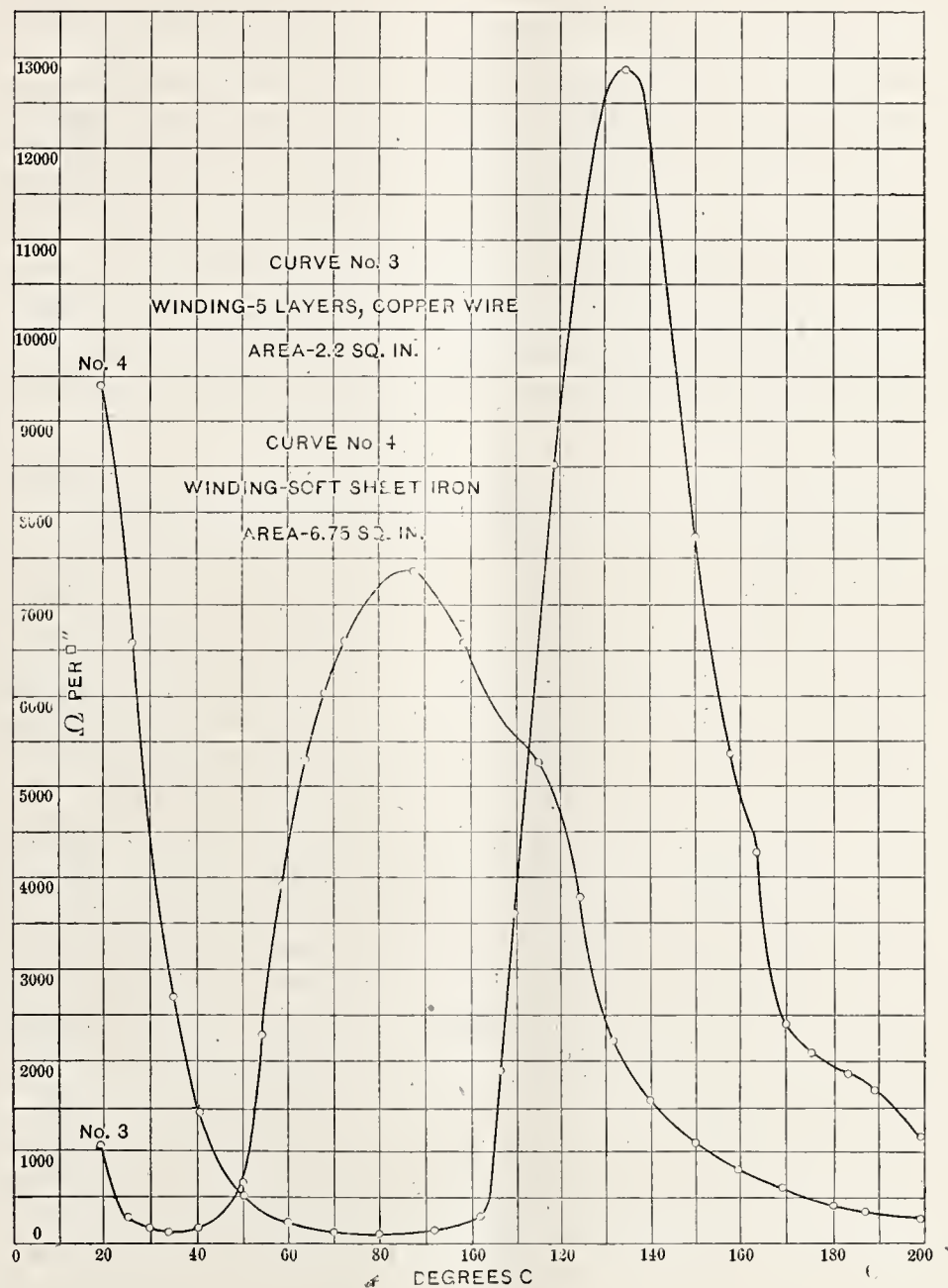


Fig. 2.

been selected. Its thickness is about .009 inch.

The Apparatus.

This consists of two distinct parts, viz.: the device

end is open. The terminals come from the ends of this set of resistance coils through the bottom of the heater, and are then connected through a suitable switch to a 110-volt circuit. This heater is supported on three

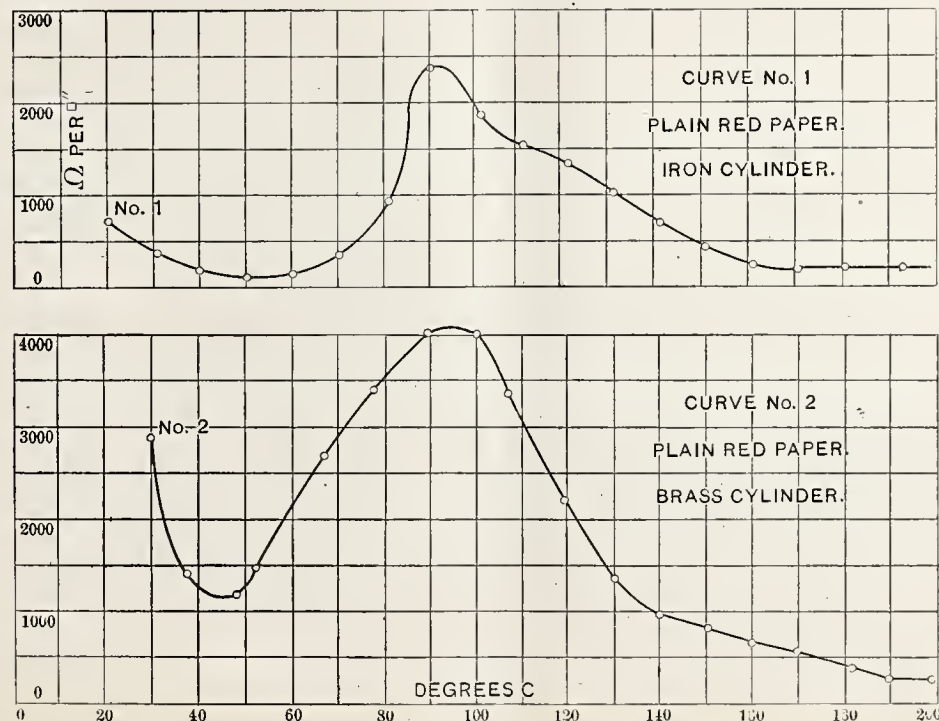


Fig. 1.

for heating and that for testing the insulation resistance. The heating apparatus consists of a single electric heater,

porcelain insulators, which rest on a slab of slate one and one-half inches thick and one foot square. The heater

takes exactly four amperes of current when all other resistance is cut out of the circuit.

Around the heater is placed an earthenware cylinder one foot high and nine inches in diameter. This provides an excellent method of keeping the heat in, and together with the electric heater secures perfect regulation of temperature. The terminals of this heating circuit are brought directly down and out from the heater through the base slab of slate to the terminals of a 110-volt lighting circuit, and are thus kept entirely separate from any other part of the testing apparatus.

Resting on an asbestos collar and at a height of about 2 inches above the heater, in the earthenware cylinder, is placed a circular iron plate $\frac{1}{8}$ inch thick, which is one terminal of the testing circuit itself and is connected to one binding post of a Thomson high resistance galvanometer; a standard megohm being placed in series between the two.

The insulating material to be tested is wrapped on an iron cylinder 3 inches in length and having an external diameter of .875 inch, the insulation not quite reaching to the ends of the cylinder. The insulation is then wound with No. 26 B & S bare copper wire. This winding makes the other terminal of the testing circuit, and is connected to the other post of the galvanometer. The iron cylinder, upon which the insulation is placed, is then placed upright on the above mentioned iron plate. Thus it will be seen that the insulating material now separates the copper wire winding, as one terminal, from the iron cylinder which is now in contact with the iron plate, as the other terminal. The leading-in connections to these terminals pass through small holes bored in the earthenware cylinder. Glass insulators are used in these holes in order to prevent any current from creeping across from one wire to the other over the surface of the earthenware. Heavy covers of asbestos board are placed over the top of the earthenware cylinder and this again is entirely covered with a large glass globe.

The potential used in this circuit is 500 volts. A suitable shunt, consisting of one or two turns of bare copper wire wound on each end of the sample of insulation, so situated that they would intercept and shunt past the galvanometer any current tending to leak along the surface of the insulation from the iron cylinder to the winding, that is, from one terminal to the other, is used in order that a deflection of the galvanometer will be produced only when a current actually passes through the insulating material under test.

In making the apparatus we have been particular to eliminate all metals with the exception of iron and copper, thus avoiding any possibility of the volatilization of zinc, which was one of the points raised in regard to the previous tests.†

This apparatus, when complete, works admirably, absolutely no difficulty being experienced with either the heating or the testing circuit.

The questions that we have attempted to answer by this investigation are four in number, viz.:

1st. Does the presence of brass or other metals from which zinc may become volatilized, in the apparatus in which the test is conducted, affect the insulating material or its behavior?

2d. Why should one experimenter obtain an insulation resistance curve for fibre, whose minimum point is at about the same temperature as the maximum point of an insulation curve obtained from similar material by another experimenter?

3d. What effect on fibre insulating material is produced when it is subjected to conditions similar to those likely to occur in dynamo-electric machinery?

4th. What is the action, or actions, that take place when fibre insulating material is repeatedly heated from 20° C. to 200° C.?

Question No. 1 has been approached in the following manner: The resistance of the insulating material at the

temperature of the air, or 20° C., being determined, the temperature is gradually raised until 200° is reached, when the test is discontinued. The time taken for this rise was exactly 2½ hours. Resistance measurements are made at frequent intervals, and from these curve No. 1 is plotted. The area of insulation tested being 5.5 square inches, thickness = .0095 inch.

The position and shape of this curve agrees very closely with the results obtained by Messrs. Monell and Perry, who in their experiments used a brass cylinder, but a confirmatory test with a brass cylinder was also made in our apparatus. This experiment was deferred until the completion of all other experiments.

Curve No. 2 thus obtained from a like sample of insulating material, thickness .0095 inch, area tested = 4.6 square inches, showed that the presence of brass in the apparatus does not affect the shape or position of the curve.

In taking up question No. 2 it is intended to prove, by comparative tests, that the position of the maxima and minima points of the resistance curves depends upon the opportunity of escape given to the moisture originally contained in the specimen.

Curve No. 3 shows the results from a test on a sample of plain red fibre, thickness .009 inch, the area of insulation under test being 2.2 square inches. In this case five layers of No. 26 B. & S. bare copper wire were wound closely upon the fibre, the length of winding being only .8 inch.

Curve No. 4 has been obtained from a test on a specimen cut from same sample wrapped with a sheet of thin malleable iron held in place by a number of layers of tightly wound copper wire, thus approaching the conditions under which the experiments cited by Mr. Scott were made. The area covered by this iron wrapping is 6.75 square inches. This test consisted, as before, in gradually raising the temperature from that of the air to 200° C., the resistance being measured at frequent intervals. The curve obtained under the above conditions is almost identical with that published by Mr. Scott.‡

It is clear from these two experiments that the position of the curve may be shifted at pleasure by simply varying the opportunity for the escape of the moisture originally contained in the insulating material. That is to say: if we wind our specimen with wire and only cover a small area, we find that the moisture has a much better chance of escape than if completely covered with an iron wrapping extending over a large area, and that the curve will actually take a position depending upon the rapidity of escape of the moisture. In the case of the wire-wound specimen the moisture escaped not only through the interstices between the wires, but also, and to a much greater degree, from the exposed ends which it reaches through the pores of the material; while with the iron-wrapped specimen the only chance of escape is from the exposed ends. Therefore, the greater the area covered, the longer will be the path traversed by the moisture and consequently a longer time or higher temperature will be required.

Question No. 3. A new specimen of plain red fibre .009 inch thick was wound with four layers of No. 26 B & S. bare copper wire, the area covered being 4 square inches, and then subjected to the variations in temperature and exposure to moisture which are most likely to take place in dynamo-electric machinery.

Insulating material when used in this way is subjected to repeated heating and cooling, being kept at a moderately high temperature for varying lengths of time; also being exposed more or less to the moisture in the air. Therefore, the following eight tests have been made under conditions approximating the above and upon the above-described specimen.

In all of these tests the temperature is gradually raised from that of the air, 20° C., to 80° C., at which temperature it is kept constant for 3½ hours. The time taken

to raise the temperature this amount is about 45 minutes.

Curve No. 5 has been obtained from the first heating. The specimen was then allowed to stand unexposed to moisture for sixteen hours, at the end of which time a like test is made, giving curve No. 6. After a lapse of 24 hours, during which time the specimen was exposed to the atmosphere, which was very damp, the temperature

days (72 hours) having elapsed, the specimen being undisturbed and unexposed to the atmosphere, is subjected to further test, giving curve No. 8.

Great care is now taken to protect the specimen from all moisture for sixteen hours; at the end of which time, upon again testing, curve No. 9 is obtained. The test consisted, as before, in raising the temperature to 80° C.,

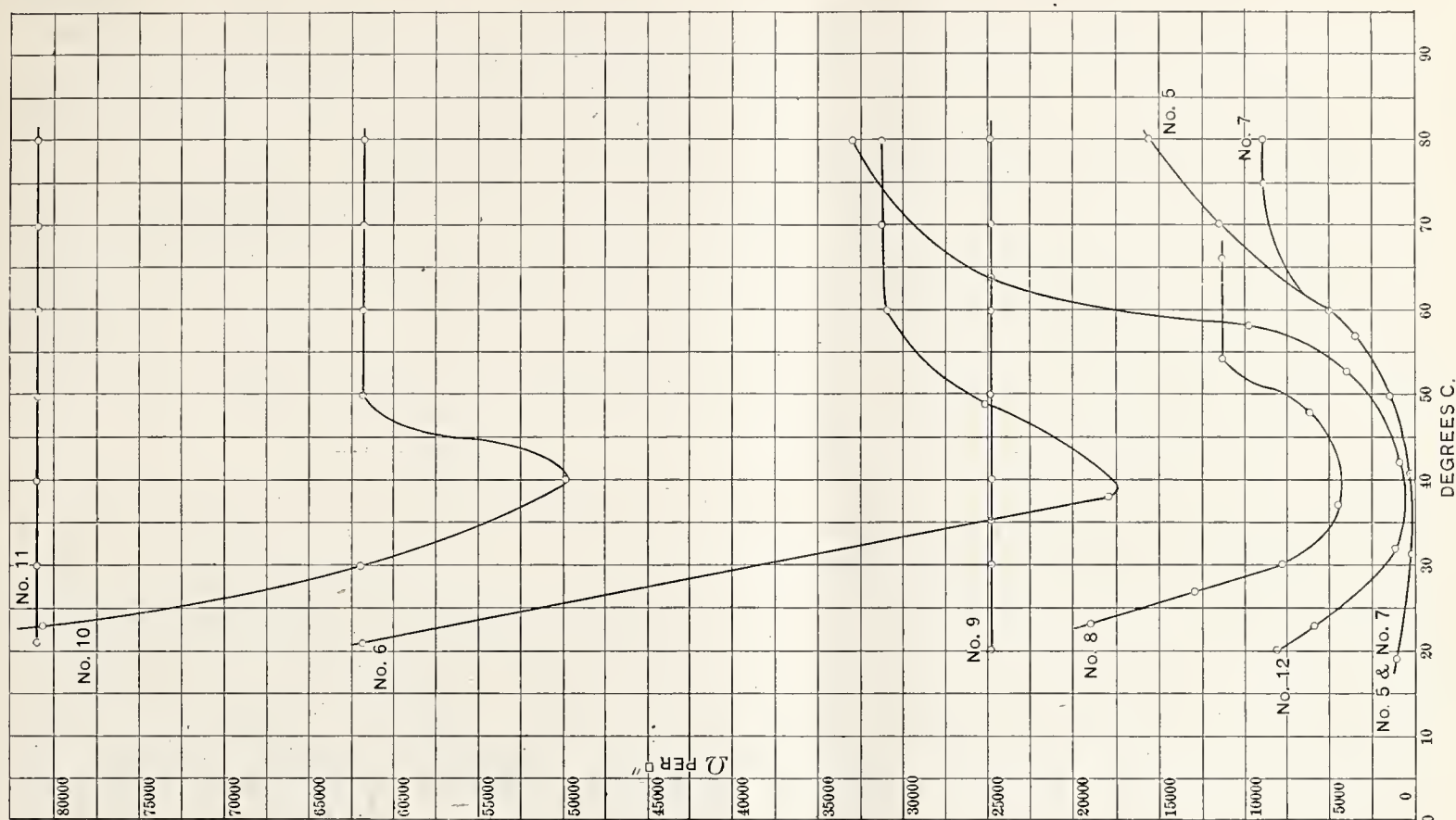


Fig. 3.

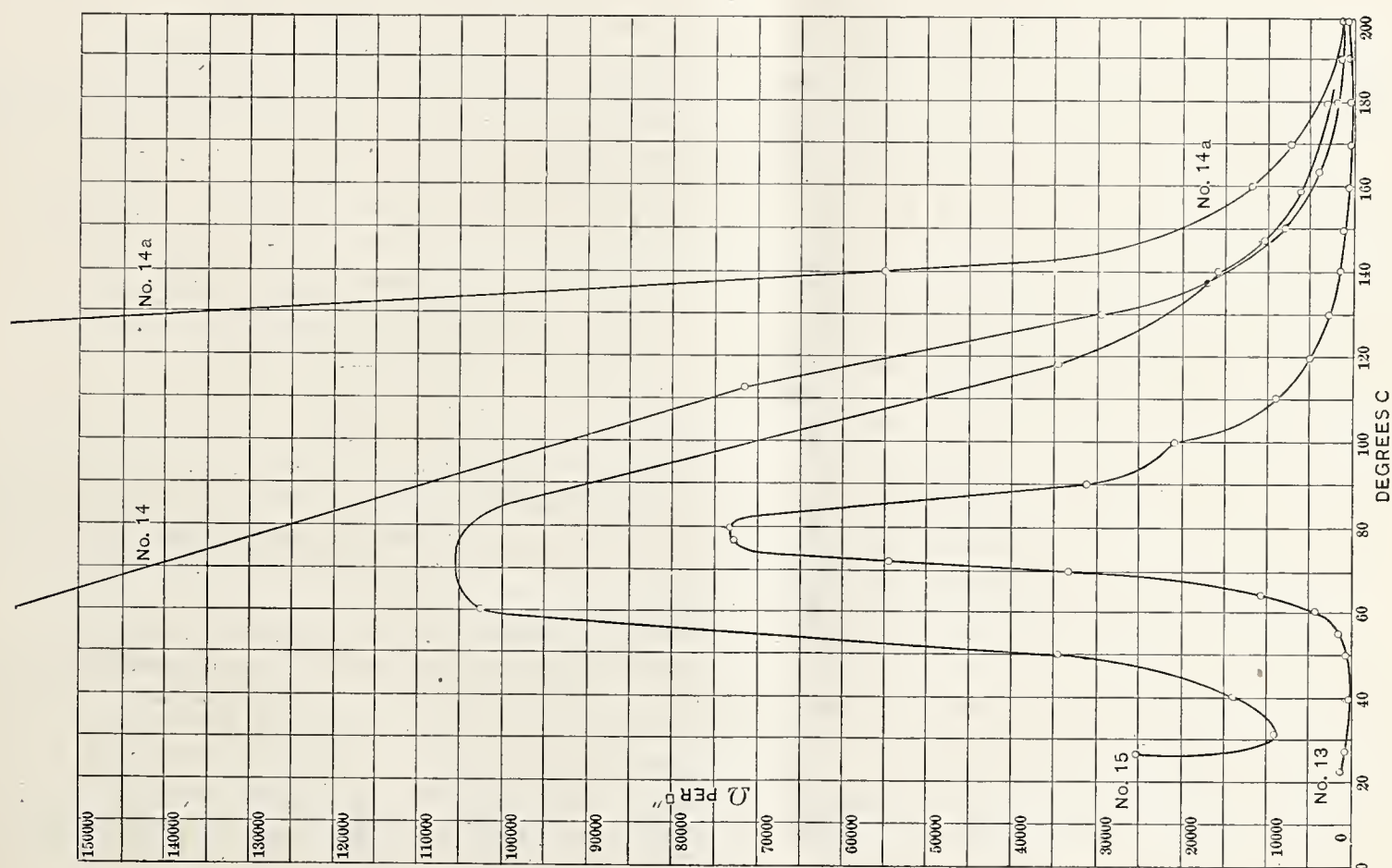


Fig. 4.

is again gradually raised and kept constant as before, curve No. 7 resulting.

It will be seen by examination of these curves that the specimen after exposure to moisture returns to its original condition. The method of exposing the specimen to moisture is to remove the glass globe from the apparatus and the asbestos covers from the top of the earthenware cylinder, the specimen itself being undisturbed. Three

where it was kept constant for 3½ hours.

All covering is now removed and the specimen allowed to cool to 23.3° C., the time occupied being three and three-quarter hours. Curve No. 10 is then obtained upon reheating.

Again great care is taken to protect the specimen from disturbance and all moisture for nineteen hours. On being again subjected to test, curve No. 11 results.

Now the specimen is allowed to stand for exactly five days freely exposed to the moisture of the atmosphere, it being situated in a room near a window which is left open a considerable portion of the time, thus subjecting the specimen to conditions of atmosphere similar to those occurring in a station or factory.

The weather during the five days was unusually damp. A number of severe rain storms occurred, thus giving the specimen an extremely good opportunity to absorb moisture. At the end of this time a test was made, from which curve No. 12 was derived.

The object of this test is to see if, after exposure to moisture, the material will return to its original condition. By a glance at the curve thus obtained it will be seen that this actually takes place.

Let us now compare the eight curves. Curve 5 represents the original resistance variation of the material. Curve 6 shows the increased initial resistance on cooling, the specimen having been protected from moisture in the meantime. Curve 7 shows the return to the original condition on absorption of moisture. Curve 8, the higher value of the resistance curve when the specimen has been kept at 80° C. for three and one-half hours and then allowed to cool, but not exposed to moisture. Curve 9 shows that the heating up to 80° C. has practically no effect on the resistance after the moisture has been driven out and not allowed to return. Curve 10 shows the condition into which the specimen was thrown when cooled while exposed to the atmosphere. Curve 11 indicates that the moisture had again been practically all expelled and therefore the heat produced no change in the resistance. Curve 12 shows that the specimen, having been freely exposed to moisture, has returned to almost its original condition.

In all these tests the resistance remained constant during the entire time that the temperature was kept constant. On examination, the specimen was found to be practically unchanged in appearance, mechanical strength or other qualities. One might therefore conclude, on inspection of the various curves in connection with these experiments, that the action which takes place in a fibre insulating material when heated up to about 80° C. merely depends upon the amount of moisture contained in the material at the time at which each measurement is made.

Question No. 4 may be answered by reference to the curves obtained from the three tests on one piece of insulating material wound with four layers of No. 26 B. & S. bare copper wire. Area of insulation under test was 4.125 square inches, and the thickness was .009 inch.

Curve 13 is the resistance curve for the first heating from 20° C. to 200° C.

The descending portion of the curve between 23° C. and 40° C. is probably due to the coalescing of the moisture within the material; that portion between 40° C. and 80° C. shows the rise in resistance due to the expulsion of the moisture and the remainder the negative resistance coefficient which insulators usually possess.

This test being completed, the specimen was allowed to stand undisturbed and protected from moisture for twenty-four hours. Upon reheating, Curve 14 was then obtained. This shows the rapid drop from the enormous resistance acquired by the material on cooling from the previous test.

While the specimen was cooling from the heat applied in test 14, frequent measurements were made, resulting in curve (14a.), which shows the rise to a still higher resistance than before. At 100° C. the resistance was too great to be measured by the apparatus at hand.

Now the specimen was allowed to stand undisturbed for thirty-six hours, during which time the air in the apparatus was kept moist. Curve 15 was then obtained on repetition of the test, showing that the material

when repeatedly heated to 200° C. still retains its property of absorbing moisture, and the effect upon its insulation resistance is not as great as would be expected. But it should be noted that this high temperature of 200° C. greatly injures the mechanical strength of the insulating material.

From the foregoing we may derive the following general conclusions:

a. The presence of brass in the apparatus does not affect the shape and position of the curve.

b. The difference in the curves depends solely upon the amount of moisture contained in the material and its opportunity of escape.

c. Every time the specimen cools the resistance increases to a value much above any resistance that it possessed before, provided it is kept from absorbing moisture.

It is impossible to determine the limit of this action with the present apparatus. But all the curves, particularly Nos. 5 to 13, clearly show this stepping-up effect, which is practically the same as the well-known result obtained by baking insulating materials.

W. C. VOSBURGH MANUFACTURING COMPANY, LIMITED.

The W. C. Vosburgh Manufacturing Company, Limited, Brooklyn, New York, beg to announce to the trade and the public in general that on and after August 1st, 1898, the Chicago General Fixture Company, 169 Adams street, Chicago, Ill., will act as the Western Selling Agents for the W. C. Vosburgh Manufacturing Company, Limited, in the territory formerly covered by them from Chicago.

The Chicago General Fixture Company will be in a position to sell the goods manufactured by the W. C. Vosburgh Manufacturing Co., Limited, namely: Gas, Electric and Combination Fixtures, on the same terms and prices as bought direct of the Vosburgh Company, and will have if a complete line of latest styles on exhibition.

Mr. Nate L. Maher, who has visited the trade for many years, will continue to do so for the Chicago General Fixture Company, and in the interest of the W. C. Vosburgh Manufacturing Co., Limited.

W. C. Vosburgh Manufacturing Co., Limited,
H. C. BECK, President.

CANADIAN LETTER.

ELECTRICAL NEWS.

Brantford, Ont.—The fire and light company have abandoned the proposal to install a municipal lighting plant, and have recommended that a street lighting contract be entered into with the Brantford Electric and Operating Co.

Lucan, Ont.—Dr. Shaw is making arrangements for building telephone lines to some of the neighboring villages. We understand that a line will first be built to Southgate in London township and afterwards to Saintsbury and Mooresville.

Orillia, Ont.—Tenders are invited for the street lighting plant, an incandescent plant, power service and steam plant. Particulars from town clerk, or R. J. Parke, consulting engineer, Toronto.

Charlottetown, P. E. I.—The Charlottetown Light & Power Co. was granted incorporation at the last session of Parliament.

Shawville, Que.—A joint stock company is being formed for the purpose of constructing electric light and water works systems.

† Transactions, Vol. XIII., page 233.

§ Transactions, Vol. XIII., page 239.

The Electrical Age.

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NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, AUGUST 6, 1898.

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THE ENDOWMENT OF COLLEGES OF ENGINEERING.

The wealthier class of this country are readily responding to the universal demand for greater educational facilities. They add college after college to the increasing list, endowing each with money sufficient to keep it alive and prosperous. It has, in fact, been the ambition of some of our greatest philanthropists from the very days of childhood to rear an edifice within whose walls educating influences would exert to the full their beneficial effect upon the generation passing in and out in an endless stream. Princely gifts have been made by the millionaires of this land in the erection and endowment of engineering institutions for the American public. Mr. Philip A. Armour established the Armour Institute of Technology at Chicago by giving it as a foundation \$1,000,000.00 cash. To this he has recently added \$500,000.00 more. This institution has 1,100 students enrolled, and, under the tutorship of Prof. Wilbur M. Stine, has developed one of the finest courses in electrical engineering to be found on this continent.

The giving of one million and a half dollars by an individual for educational purposes is in this case equivalent to a great national service. From a humanitarian standpoint, its far-reaching results upon society and the world can hardly be estimated. To remove the famine from India or bring immediate relief to the reconcentrados of Cuba is not a greater deed than this. To allay pain, hunger and thirst in a multitude of suffering wretches deserves and does receive world-wide applause, but, judged from the standpoint of time, it is to be expected, as such things will recur until poverty has succumbed, with its host of evil followers, to the influence of an elevating civilization. It is true that in the acquirement of wealth gladiatorial combats occur and men ride rough-shod over each other, but in its disbursement they seem at times gifted with a lofty inspiration.

The creation and endowment of colleges of engineer-

ing or other great public institutions will shed a lustre on the life of the donor sufficient to bring out with startling prominence all qualities of goodness. The Vanderbilts, Astors, Peter Cooper, Roosevelts, Stevens and Armours are names that will be remembered in the history of progressive civilization.

THE BESSEMER PROCESS AND ITS INFLUENCE UPON ELECTRICAL MANUFACTURING.

The technical value of a discovery is always the basis and cause of its commercial success. All great inventions exercise a far-reaching influence over industries directly dependent upon the discovery, and frequently upon industries still inchoate, the development of which is largely attributable to a newer application of the same.

The efforts, failures, and, finally, the brilliant success of Bessemer firmly established his reputation as a genius of high order, and brought into existence a process of untold value to the arts and sciences. The Bessemer process of turning pig iron into steel has been of the utmost benefit to manufacturing electricians.

The modern dynamo possesses a framework of mild steel. Its present size and state would be difficult to utilize and expensive to produce were cast and wrought iron still exclusively used. But by the development of this refining process instituted by Bessemer mild steel is produced in large quantities at a low price, possessing magnetic qualifications that make it compare most favorably with wrought iron. Some concerns using drop forgings of wrought iron found that the expense of constructing large machines in this manner was so great as to prohibit the further extension of their business along these lines. A cast iron machine was practically out of the question on account of its great size and weight, power for power, in comparison with one of wrought iron. The use of cast steel was then seriously considered, and it was found that it answered the purpose almost as well as wrought iron.

A square inch of cast iron will carry about one-half as many lines of force as a square inch of wrought iron. A square inch of mild steel will carry from within ten to fifteen per cent. of the lines of force of wrought iron without involving the use of heavy magneto-motive forces.

This demand on the part of electrical manufacturers for mild steel has added considerably to the activity displayed in that field of work by producers of the same. Steel has displaced cast iron of late on so many occasions that it seems likely to entirely supersede it in the next century and be exclusively employed for all kinds of engineering work where reliability and strength are important factors of consideration.

Lindsay, Ont.—The telegraph and electric light company will probably be asked to lay their wires underground.

Woodstock, N. B.—Improvements are to be made to the fire alarm system, including four miles of iron or copper wire.

Iroquois, Ont.—A proposition to furnish electric light has been made by Mr. Keefe.

Barrie, Ont.—The town will install an up-to-date fire alarm system.

Thorold, Ont.—The rate-payers will be asked to sanction a loan of \$7,000 to extend the electric light plant.

Maniwaki, Que.—An electric plant will likely be installed for public and private lighting.

Wallaceburg, Ont.—The local electric light company have decided to install an incandescent plant within eight months.

RAILWAY MOTORS AND CONTROLLERS.

(Continued.)

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The use of motors for track service is limited to those of the series type. A series motor possesses advantages over the shunt that both experience and theory indicate. The current flowing through a series motor passes from brush to brush via armature and field. The speed and pull of the armature can be changed at will by varying the pressure applied to the armature and its current and field.

(2) The two motors thrown in multiple.

(3) Subdivided fields thrown into multiple.

To each of these general processes there are subdivisions; that is, the rheostat contains steps which regulate to some extent—the motors may be thrown in multiple, or their fields and armatures separately, and in addition different combinations may be made of the commutated fields. The practical result of all these changes is to increase the current flowing through the motors by successive stages until the pressure and current is at a maximum.

The heaviness of motor cars has necessitated the use of strong steel rails and a secure bond. The cars used are not very different from the old horse-car style, except that they are better furnished, more capacious and in every respect more comfortable. Both station, track, car and motors are a source of expense to the company. The station has machinery which depreciates; the track re-



Third Rail Car Equipment.

The pulling power of any armature depends upon the

(1) Current in the armature.

(2) Strength of field.

The series motor is naturally adapted by its construction to an easy system of regulation. Not only can the current be varied outside by having a rheostat in series with the motor, but the magnet coils can likewise act in this capacity by being subdivided. A series motor connected to a rheostat and having commutated or subdivided field coils can be regulated both in speed and power by these means.

A trolley car is usually equipped with two motors. They are both series motors with commutated field coils. A small rheostat is in series with the pair. To vary the speed and pull of the car an automatic switching device called a controller is used.

Function of a Controller.—When the car is at rest the rheostat and both motors are in series. To start the car and put it through its different speeds, the controller, which consists of a cylindrical vertical commutator, is revolved. The general result is as follows:

(1) The rheostat and two motors in series.

quires many repairs unless well put down, and even then the rails wear out; the motors have armatures which constantly burn out and the cars become scratched and shabby from daily use.

Trolley lines running over hilly ground are apt to incur more expense from repairs than those installed on more level ground. The reason for this is traced to the greater strain upon the motors when climbing hills. The work the motor performs is divisible into two parts—that of advancing and that of lifting itself the height of the hill. In certain localities it seems evident that a cable system would be best; that is, a very hilly district. Block electric, open conduit and storage battery systems are occasionally heard of. In New York city, perhaps, the conduit system is receiving the best trial of all. Several of our largest railroads are about to permanently adopt electric cars for special purposes; the B. & O. being the most prominent of all.

QUESTIONS FOR REVIEW.

(1) What type of motor is exclusively used for traction purposes?

(2) Upon what elements does the pulling power of an armature depend?

(3) How is a series motor regulated?

(4) What is the function of a controller?

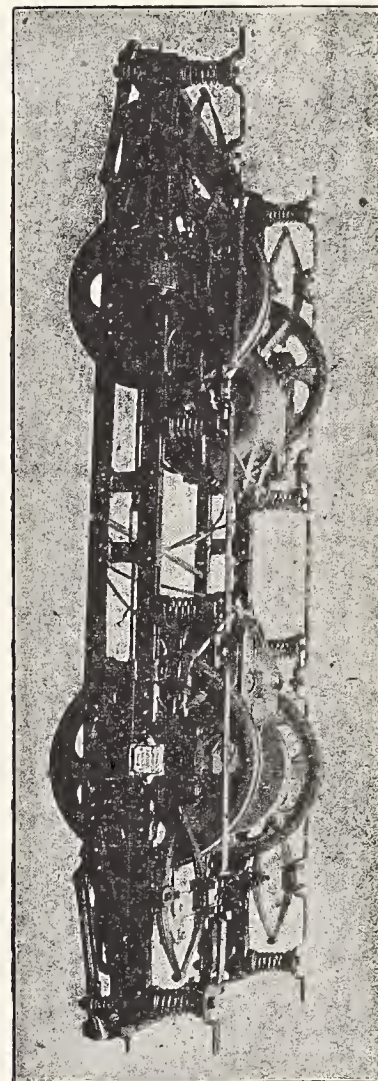
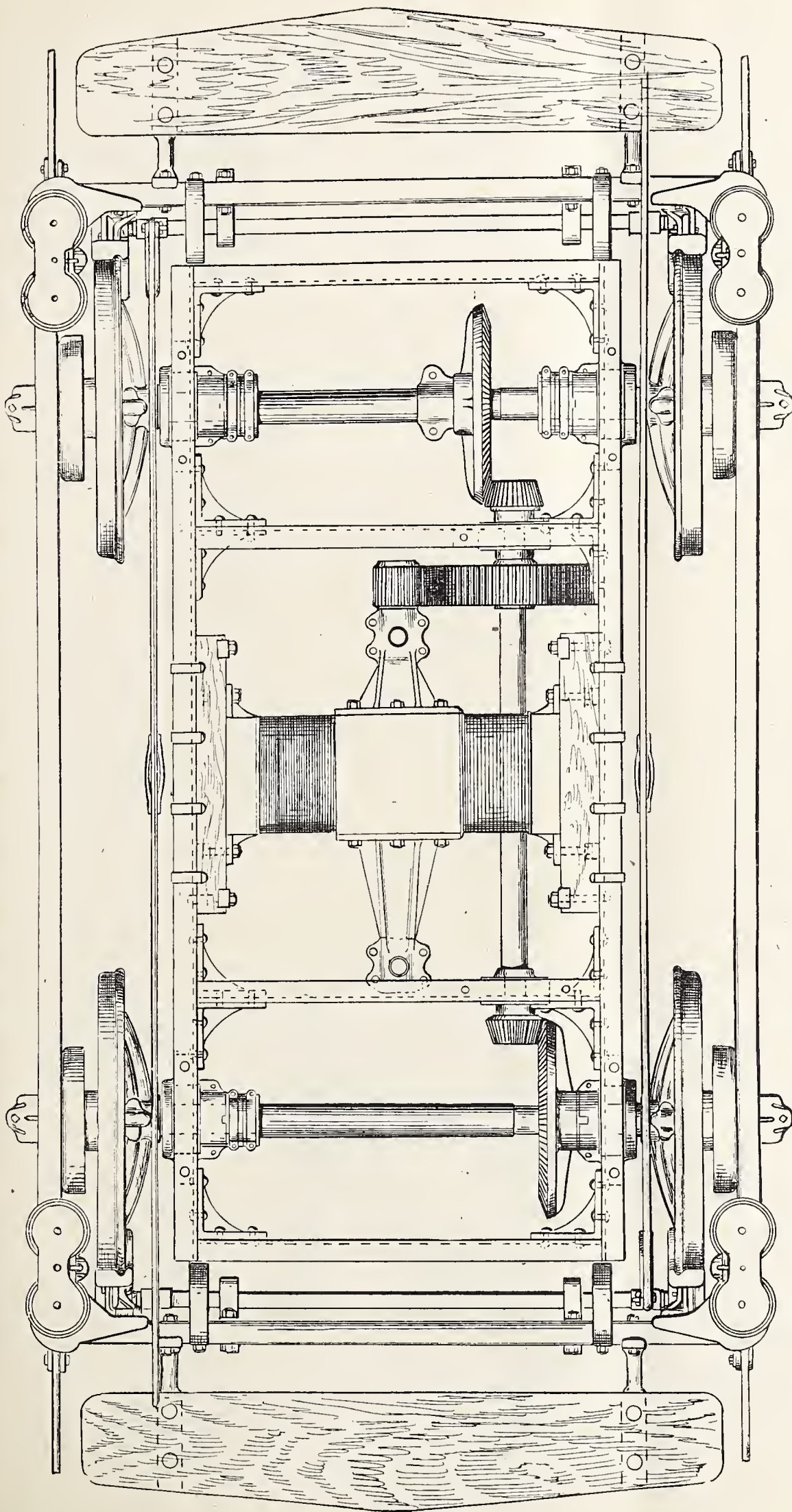
(5) How does the controller effect changes in the speed and torque of the motor?

Conclusion of Article on Electric Railways (page 23) with Questions for Review.

DROP OF POTENTIAL.

It is necessary to appreciate the fact that the loss from leakage and the drop of potential seriously interferes with

Plan of Early Motor Car Equipped with Double Reduction Gearing.



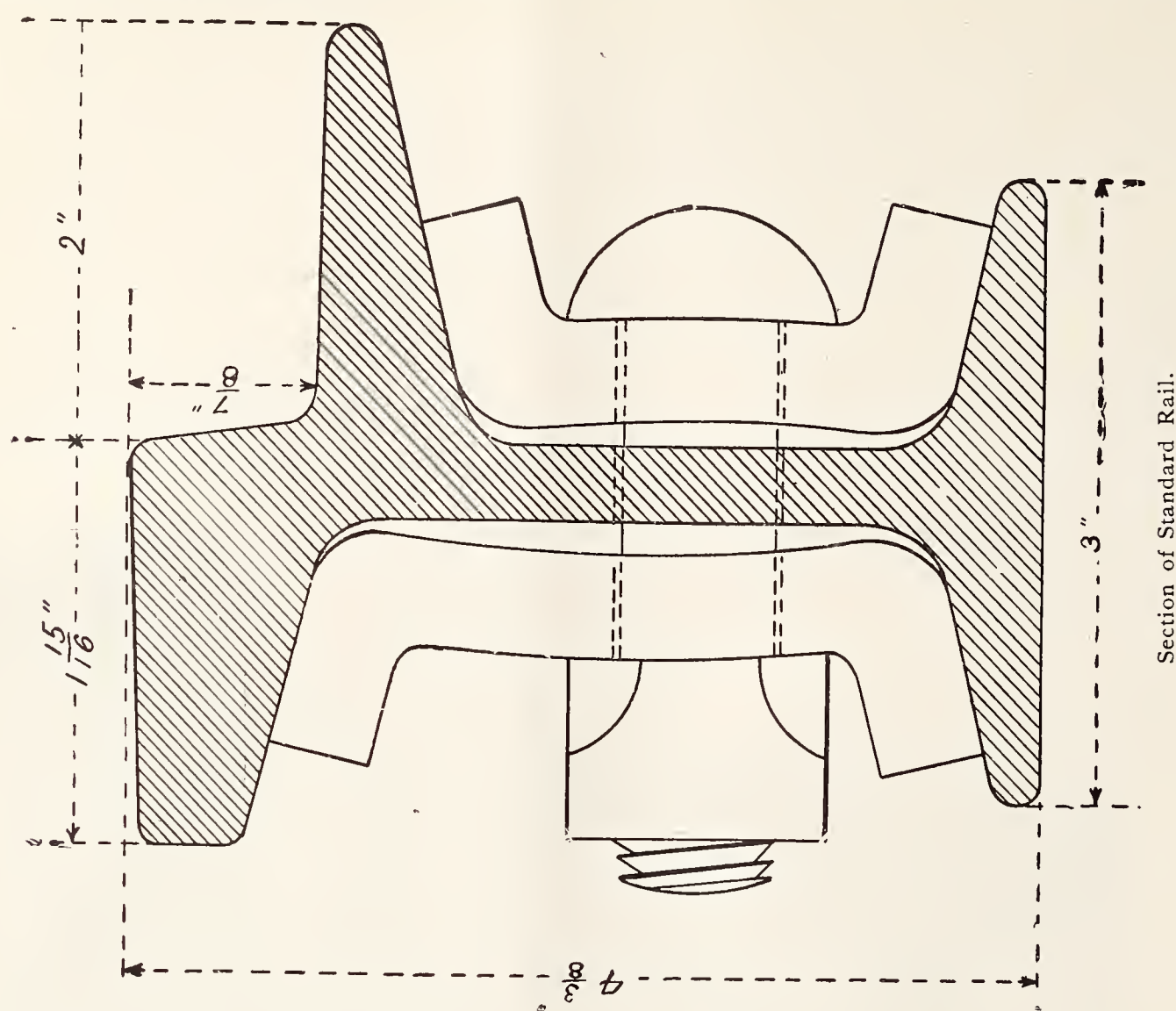
Modern Motor Truck.

London, Ont.—The city council has decided to call for tenders for a municipal electric light plant.

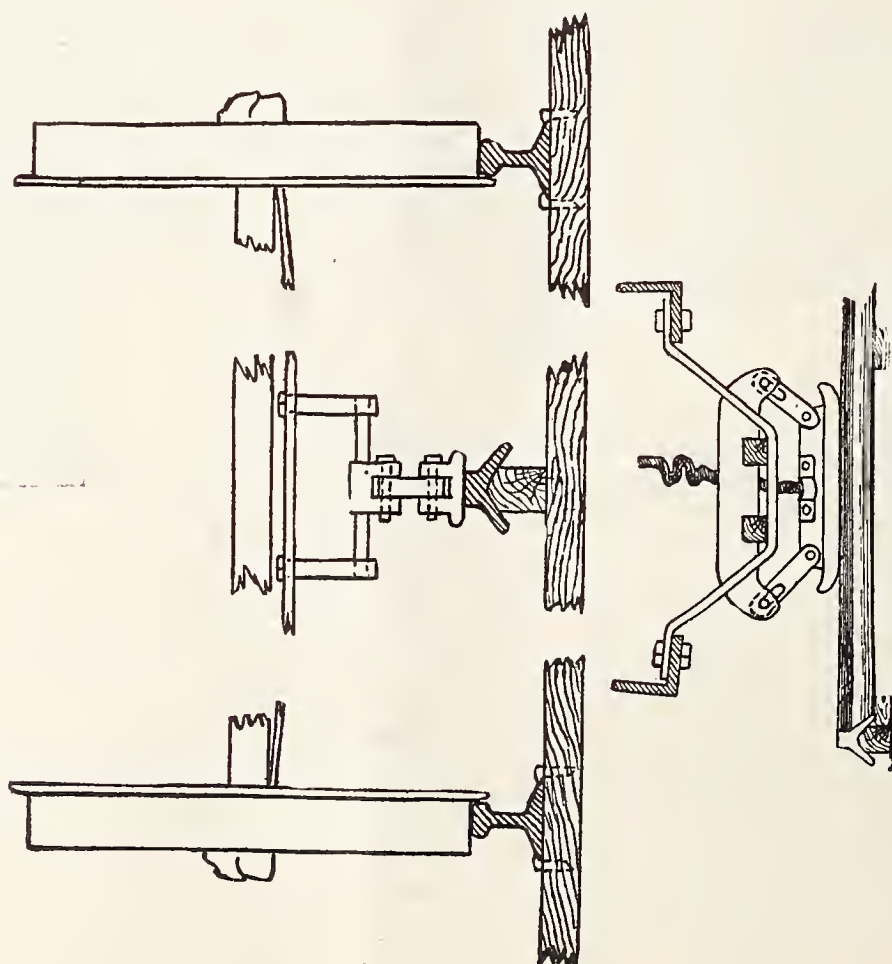
the efficiency and growth of a line. The leakage may be reduced by careful insulation, but the loss of pressure

only by a successful and necessarily practical method of joining the parts entering into the circuit. The circuit in an open conduit system is two continuous copper wires or something similar reinforced by a system of feeders, that is, auxiliary lines leading from the dynamo room or

ance—may vary from 50 to 150 volts or more. In trolley lines the tracks, being part of the circuit, must be electrically joined or bonded together. The overhead line or trolley wire is the remainder of the circuit. By having the tracks or rails welded or at least carefully joined the



Section of Standard Rail.



Details of Third Rail.

station to different parts of the line. When a set of cars takes current simultaneously from the circuit a heavy flow of current ensues. The drop of potential, calculated by the rule—drop equals current multiplied by resist-

drop of potential is greatly reduced and the system infinitely improved. In trolley lines careful attention to these points will mean a saving of thousands of dollars in installation and running.

MAX LOEWENTHAL, E. E., ASSOCIATE EDITOR
OF THE ELECTRICAL ENGINEER.



We take pleasure in noting that the editorial staff of our contemporary, "The Electrical Engineer," has been added to in the person of Max Loewenthal, E. E. Mr. Loewenthal deserves great credit for his persistent efforts in striving to reach the goal of his desire. His ambition to be a journalist is strictly in accord with his abilities in that direction. They go hand in hand, as it were, and thus open up for him a future which gives great promise to his career

as a technical journalist. Mr. Loewenthal was born in Oldenburg, Germany, in 1874. He graduated from the Hebrew Technical Institute first in his class. He served an apprenticeship in the testing department of the Western Electric Company under Mr. Geo. A. Hamilton and subsequently took charge of a similar department of the Schuyler Electric Company, in Middleton, Conn., then under the management of E. R. Knowles, the chief electrician. He entered Columbia University, School of Mines, in 1893, and graduated with the degree of electrical engineer. While taking his collegiate course he edited a monthly called "The Technical Journal," took out several patents and wrote for some well known scientific papers. He is a member of the New York Electrical Society and associate member of the American Institute of Electrical Engineers. We believe that Mr. Loewenthal is working along the lines of least resistance in entering a field of work so congenial to his training and tastes. His conscientious labors will certainly bring successes gratifying to himself and to the numerous friends interested in his welfare.

(Continued from page 80.)

QUESTIONS FOR REVIEW.

- (1) How many systems of railroading exist?
- (2) What are the objections to a storage battery system?
- (3) How does a conduit road operate?
- (4) What is bonding?
- (5) By what means is drop remedied?

THE DEVELOPMENT OF THE CENTRAL STATION.

BY SAMUEL INSULL.

(Continued from page 62.)

Lord Kelvin, commenting on Dr. Siemens' remarks of November 15, 1882, before a commission taking evidence with relation to the Edison feeder patent, said:

"There is not a word here of the necessity to secure against too great drop of electric potential between the dynamo and the lamps, or too great differences of drop between the different lamps of the system, and the narrow limitation of the area insisted upon shows that Dr. Siemens had no idea of Edison's solution of the problem, and thought only of overcoming the difficulty by enormously massive copper conductors with branches diverging from them to the points of consumption. From his earliest commencement as an inventor and engineer, Siemens had been occupied with water and gas. His first invention was a water-meter, and it is not probable that

anyone in the years 1879-80 knew better than he did of the difficulties met with in the distribution of water and gas and of the methods which had been practically used or proposed for overcoming them."

Again, referring to this same subject, Sir William Thomson said:

"About that time or a little later, one of our first electrical engineers, Mr. Crompton, who has, in fact, been the first to introduce successfully and on a large scale, lighting from a central station in London, told me that he was obliged to use larger copper conductors than would be required merely in accordance with my principle for economy, in order to avoid so great a drop in potential as would be inconsistent with the good working of the lamps. At that time he had no idea of the feeder system, which he has since adopted with marked success in the Kensington-Knightsbridge electric lighting. Siemens' solution was not augmenting the size of the conductors above that calculated from the economic law, but to limit the size of the station supplied. Neither this nor the solution first proposed by Crompton is satisfactory in respect to the practical demands for the electric lighting of towns. Edison's feeder system is now universally admitted to be satisfactory to a very remarkable degree. I am asked why did not some one else invent it. The only answer to this, the last part of the question that I can think of, is that no one else was Edison."

I personally well remember Sir William Thomson's visit to the Pearl Street station in New York, in 1884, when he saw the Edison feeder system first in operation, and the great interest that he exhibited in studying it, and his admiration for the work accomplished by Mr. Edison in this connection.

I have thought it necessary to thus quote at length some of the leading English authorities on electrical matters, as I thought it would be better in claiming for an American the conception of the true basis of electrical distribution for light and power purposes, to give you the opinion and views on the matter of distribution of our "kith beyond the sea" rather than to quote the views of American scientists who might possibly be considered more partial to the work of their own countryman.

It is often said that the principles of constant potential multiple distribution and the use of feeders to maintain an equal and economical distribution of pressure are self-evident propositions, following the lines of gas and water distribution; but when you have such high authorities as Conrad Cooke, in 1879, failing to recognize any of these necessities, of Mr. Swan in 1880 only recognizing the principles of multiple arc, and in 1882 failing to recognize the importance and far-reaching results of the feeder system, and Dr. Siemens as late as November, 1882, two months after a central station was in operation in New York city, adopting almost the same views as Mr. Swan, you cannot wonder at Lord Kelvin answering the question as to why someone else did not invent the feeder system by saying "The only answer to this, that I can think of, is that no one else was Edison."

It would seem to me, with such authorities, that it is not unreasonable to claim that the development of the central station and distribution system connected therewith dates from Mr. Edison's work at Menlo Park. Mr. Edison had been engaged during the early '70s, first as a telegraph operator in the Western Union service, and later working on the gold indicators in the gold-room in New street, New York, during the stirring period of speculation in the precious metal which culminated on Black Friday in 1873. Prof. C. C. Law, now connected with the University of Missouri, had, I believe, charge of the indicating instruments, and it is a matter of some interest to record the fact that the first work Mr. Edison did of an inventive character which yielded him a financial return was in connection with and while he was at work on the gold indicators in question. Subsequently he was

employed in the interest of what is now the Western Union Telegraph Company in improving the now universally used stock-ticker. This work was followed by brilliant and successful work in connection with the duplex and quadruplex and automatic systems of telegraphy, and the invention of the phonograph and that part of the telephone now generally used for transmitting purposes and known as the carbon transmitter. His attention to the possibilities of what is popularly called the subdivision of the electric light was probably the result of a visit he paid to Mr. William Wallace at Ansonia in the fall of 1878, where he saw some experiments on dynamo machines, and on his return to Menlo Park he started his experiments on a system of electric light and power, which culminated in the successful starting of the first central station, in the lower portion of New York city, in September, 1882.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the meeting of the Executive Committee, June 24th, Mr. C. O. Mailloux, of New York, was elected a Vice-President of the Institute to fill the vacancy caused by the previous election of Dr. A. E. Kennelly to the Presidency. Mr. Robert N. Baylis was also appointed a member of the Board of Examiners, succeeding the late Dr. Chas. E. Emery.

The following Associate Members were elected:

Walter Cummings Allen, inspector of electric lighting, Government of District of Columbia, District Building, Washington, D. C.

Albert H. Armstrong, electrical engineer, General Electric Co., Schenectady, N. Y.

George A. Damon, with B. J. Arnold, Electrical Engineer, 1541 Marquette Building, Chicago, Ill.

Frank H. Dexter, student Cornell University; residence, 51 Huestis street, Ithaca, N. Y.

P. M. Downing, Supt. Electrical Dept. Blue Lakes Water Co., Blue Lakes City, via Jackson, Cal.

Joseph Lyons, Patent Solicitor, with Gustav Bissing, 908 G street, Washington, D. C.

The following Associate Members were transferred:

Alfred A. Thresher, electrical engineer and proprietor Thresher Electric Co., Dayton, O.

William B. Jackson, New York and Staten Island Electric Co., West New Brighton, N. Y.

Paul M. Lincoln, Electrical Superintendent Cataract Construction Co., Niagara Falls, N. Y.

Thorburn Reid, Consulting Electrical Engineer, 120 Liberty street, New York City.

Philip Green Gossler, Electrical Engineer, Royal Electric Co., Montreal, P. Q.

Theodore E. Theberath, Pacific Coast Engineer, Stanley Electric Co., San Francisco, Cal.

Frederick M. Pedersen, Assistant Electrical Engineer, Crocker-Wheeler Electric Co., New York City.

Will K. Dunlap, Electrical Engineer, Westinghouse E. and M. Co., Niagara Falls, N. Y.

CANADIAN LETTER.

ELECTRIC RAILWAYS.

Montreal, Que.—The Railway Committee of the Privy Council at Ottawa considered the bills for electric railways in the neighborhood of Montreal. A charter was granted to the North Shore Electric Railway Co., which proposes to build an electric railway from Three Rivers along the northern shore of the St. Lawrence River. The Montreal & Southern Counties Railway Co. was given power to extend their operations to the counties of Beauharnois, Chateaugay, Huntingdon and Napierville. The

promoter of both of these undertakings is Mr. A. J. Coriveau.

London, Ont.—The scheme for an electric railway from London to Stratford, Arcona and Thedford, connecting the C. P. R. and the G. T. R., is making satisfactory progress.

Waterloo, Ont.—The rate-payers have sanctioned the by-law granting a bonus of \$12,000 to the Galt and Preston Electric Railway for the extension of its road.

La Patrie, Que.—There is talk of building an electric railway between this town and Scotstown.

St. Catharines, Ont.—A by-law authorizing the construction of an electric railway between this city and Port Dalhousie has received its first reading in Council.

Chicoutimi, Que.—Mr. Picher is reported to have had plans prepared for an electric railway to be built here.

Hamilton, Ont.—The promoters of the Hamilton, Chedoke and Ancaster Electric Railway state that the line will be constructed to Hamilton provided the Council buys the Beckett mountain drive.

Quebec, Que.—The Quebec, Montmorency & Charlevoix Railway Co. convert the road between Quebec and Cape Tourment into an electric line and a branch line to Montmorency Falls to be operated by electricity.

Toronto, Ont.—The Toronto Street Railway Company have had plans prepared for several proposed extensions, including a second line down Station street. This line will be built as soon as the bridge over the Yonge street track is built by the city. This bridge is estimated to cost \$200,000.

J. ALCIDE CHAUSSE.

Lansing, Mich.—Citizens' Long Distance Telephone Co. has been incorporated with a capital stock of \$5,000.

Malvern, Ark.—C. W. Turner will construct an electric plant. Bids for same are being invited until May 31.

Bivalve, Md.—John W. P. Insley is endeavoring to organize a company for the establishment of a telephone system extending from Salisbury to Nanticoke, a distance of thirty-five miles.

Neosho, Mo.—The Neosho Electric Light Co. will probably erect a new steam-power plant, abandoning its present water power.

Gallatin, Tenn.—The Mayor may be addressed for information regarding electric light plant.

Frankfort, Tenn.—The Cumberland Telephone and Telegraph Co. and the Great Southern Telephone Co. have consolidated. Capital stock, \$3,000,000.



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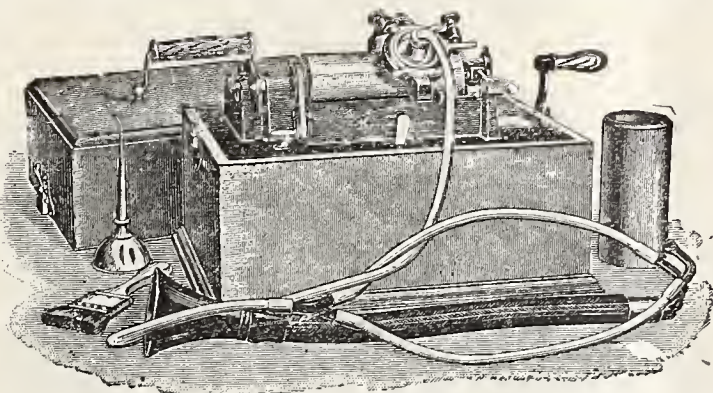
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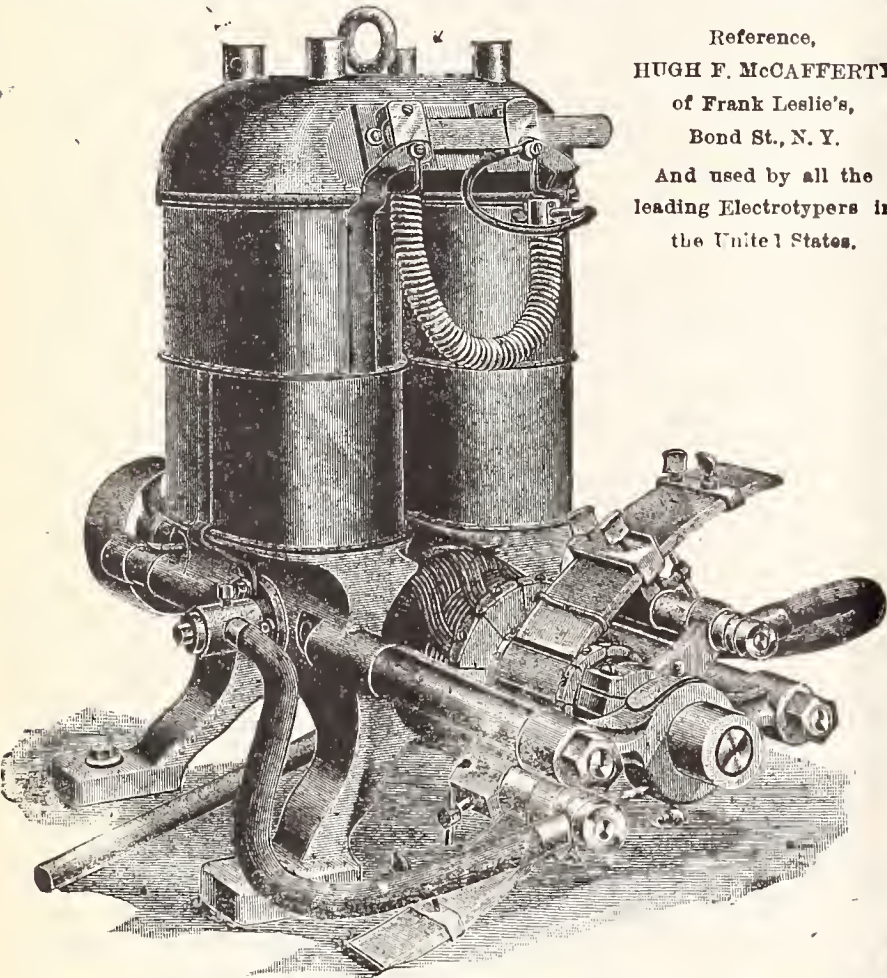
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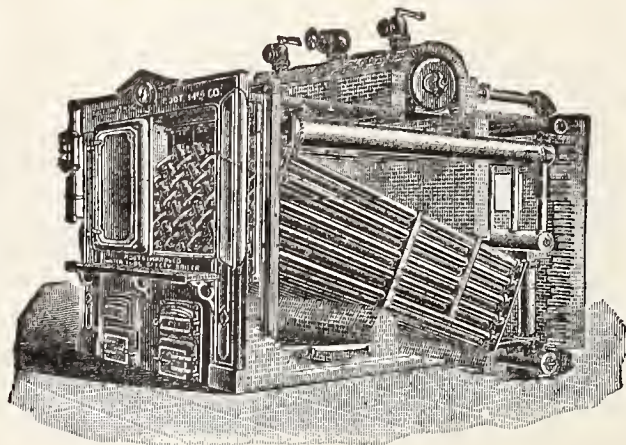
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VOL. XXII—No. 7

NEW YORK, AUGUST 13, 1898

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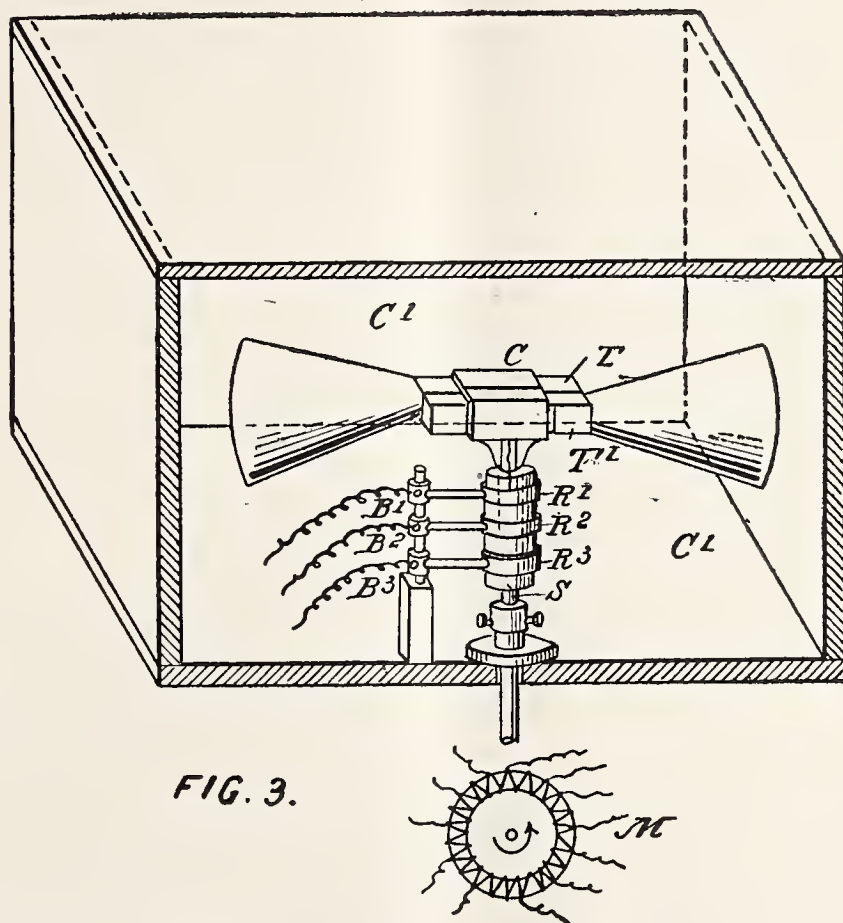


FIG. 3.

Herbert Apparatus as Mounted for Use.

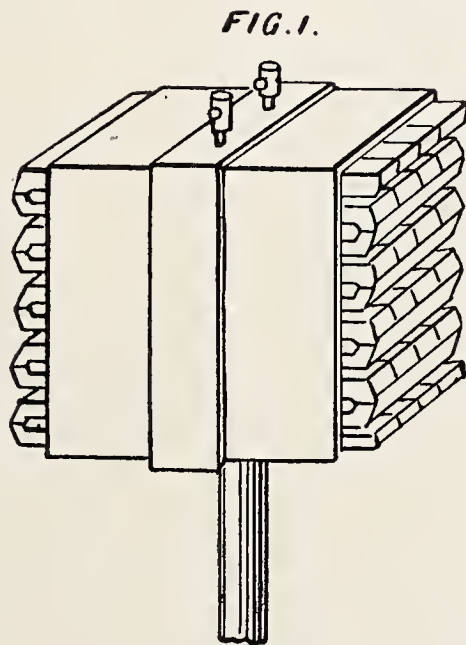


FIG. 1.

Thermopile.

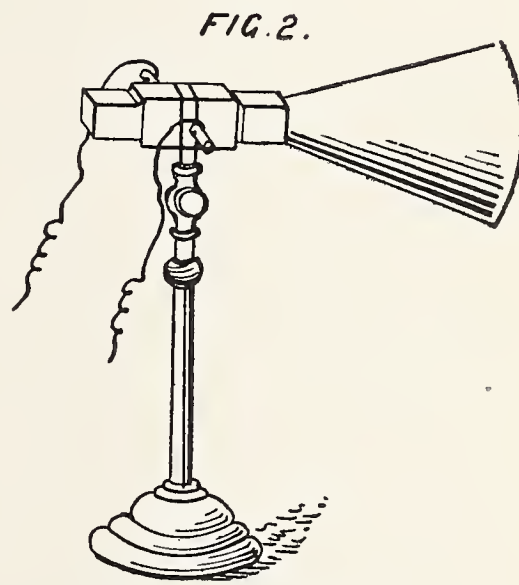


FIG. 2.

Thermopile Detector.

MEANS FOR DETECTING THE PRESENCE OF A VESSEL OR AN ICEBERG ; HOW THEIR MOVEMENTS MAY BE FOLLOWED.

The recent Bourgoigne disaster, connected with such heavy loss of life, such fearful dramatic scenes, where egotism was predominating to such an extent that barbarous means were resorted to in butchering and annihilating the weaker element, has caused a deep and everlasting impression upon its survivors, upon everybody endowed with a fellow-feeling.

The average person lacks coolness of mind in such critical moments, and in losing all self-control shakes that of those then unaffected. It seems to me that travellers should be made familiar with the safety appliances

on board a steamer, and I venture to express the hope that the Bourgoigne disaster will not only cause the different navigation companies to give to their patrons practical lessons in using and applying such expedients, but also such further information as may be of benefit to them in case of accidents. As to the matter of life-boats, improvements seem highly desirable and particularly to quick and efficient means for launching them. Many lives were lost just on account of this deficiency. It should be made compulsory for each vessel to have a total carrying capacity of their life-boats exceeding by

10 or 20 per cent. the maximum number of passengers carried.

This Bourgoigne disaster has stimulated within me the desire of finding some such suitable means whereby collisions at sea may be avoided.

Before entering into a discussion of these, it may be in order to mention a few methods of signalling now in use. Among the auricular signals we have with an approximate hearing distance in miles, the following:

The air siren,	10 to 12 miles.
The steam siren,	8 " 10 "
The trumpet,	6 "
The bell,	1 "

This hearing distance is however not constant and depends upon many conditions referred to further below.

For receiving the sounds the eophone, topophone or similar instruments have been employed with more or less success. The object of these instruments being to furnish a means whereby to determine the direction from which the sound proceeds. The eophone consists of two bell-shaped receivers separated by a central diaphragm, the further end tapering down and being connected with ear tubes. The whole is mounted in a suitable manner, whereby it is possible to point the open ends in any direction desired. If the receivers point in the direction of the sound, then each ear will perceive it with the same intensity.

Under existing conditions it is necessary that both vessels be active, not only in giving signals, but also in "attempting" to intercept them. The safety of a vessel consequently not only rests with its own crew, but largely depends upon the watchfulness of the other vessels. A good deal of blind confidence is therefore placed in any stranger who may come along; it is not this alone which makes navigation dangerous during a heavy fog, it is made much more so on account of coinciding circumstances which as yet are not fully understood. At times it is impossible to perceive the phonorous signals when the steamer is near by, while the signal was plainly heard from some greater distance. As to the cause of this surprising interruption (seeming) in the propagation of sounds, investigations have been carried on by the United States, Germany and France. The investigations made by Major Livermore, in compliance with the U. S. Admiralty, have thrown some light upon this subject. It has been deduced that obstructions to sound or an irregular formation of the coast not only materially affect the strength but also the propagation of the same. Obstructions behind the source of sounds will reinforce them in a similar manner as a screen will reflect the light. Rain and snow will have a great influence upon the direction of the sound.

It has been observed that under certain conditions a sound could not be heard near the surface of the water, while it was heard plainly some distance above it. In one experiment Major Livermore's vessel had been placed in such a position that the blowing of whistles, even the shooting of a cannon was heard at one end of the vessel most distinctly, while it was impossible to detect any sound at the other end, although the steam or smoke could be seen to arise. It seems therefore that under certain conditions sound waves may be projected upward, to descend again at some distance and finally take up their original direction. No doubt this remarkable interruption has caused many accidents.

At the first thought it seems that wireless telegraphy would meet all requirements. Reflecting upon this will soon convince us that each and every vessel afloat would have to be equipped with a complete set of apparatus. Even if their use were made compulsory, then again would the safety of a vessel largely be dependent upon the other vessels in a similar manner, as outlined above.

Although the introduction of this kind of apparatus would make navigation safer, the location and move-

ments of other vessels could nevertheless not be determined.

Besides the vessels, there are icebergs and floating wrecks.

Taking all in all it is desirable to find a means which will indicate the nearness or approach of any object.

It is well known that any object, when its temperature is higher or lower than that of the atmosphere surrounding the same, will either send forth heat radiations, or else, in the other case, absorb heat from its surrounding medium. In the winter we clothe ourselves to keep warm; in other words, we surround ourselves with a poor heat conductor so as to diminish the heat radiations from our body to the atmosphere.

If we can construct an apparatus which is acted upon by such heat radiations, and if the apparatus be of such sensitiveness that it will intercept and indicate them, even if they be exceedingly weak, then we have a means which may be advantageously employed in navigation. As soon as we can intercept the radiations sent forth from a vessel we need not depend upon our ear or eye to locate the same.

A modification of the thermopile or the radiophone may be employed in connection with this problem.

A few remarks pertaining to these may be of interest. Seebeck, in 1832, discovered that an electric current is set up in a closed circuit made up of different metals as long as the junctions would be maintained at different temperatures. The best effects have been subsequently obtained by the use of antimony and bismuth.

Fig. I. shows the assembly of suitable metal strips, surrounded by an insulating casing, forming the thermopile. The free ends of the metal strips are connected to binding posts.

Fig. II. shows such a thermopile rigidly supported and provided with a conical attachment, which is blackened on its inner surface. It serves the purpose of concentrating the radiations upon the exposed face of contact, in that way augmenting the effects.

Fig. III. shows part of an apparatus as proposed by me to the end of detecting the approach or nearness of and vessel, iceberg or obstruction. The two thermopiles, T and T₁, are surrounded by an insulating casing C, any are attached to a shaft S, which may be revolved slowly. The insulated rings R₁, R₂, R₃, serve to establish a permanent connection of the thermopiles with the brushes B₁, B₂, B₃, from whence wires may be led to the pilot house to the observation or indicating apparatus. The thermopiles are inclosed in a suitable compartment; such as to exclude all air currents, and to afford protection from the radiations of the sun and the vessel itself. For this reason the whole is mounted on the outer side of the vessel. It may therefore be necessary to have one set of apparatus at each side of the vessel, to afford proper protection. A flat, D-shaped double walled casing (not shown) surrounds the compartment C₁; the outer chamber of the former is filled with alum or other heat absorbing solution, for the purpose of intercepting radiations due to the rays of the sun either striking directly or being reflected from the water, and also for intercepting those which are emitted from the vessel itself. The inner chamber may be attached to a continuous water supply, so as to remove all heat which the alum cell may have absorbed, and also to maintain the chamber C₁ at a constant temperature; i. e., the temperature within the chamber should be constantly corresponding to that of the surrounding atmosphere, allowing for radiations just referred to.

Fig. IV. shows a diagram of connections. A junction of two of the free ends of the thermopiles T and T₁ is led to the middle ring and thence over the brushes to the two galvanometers, G₁, G₂, here shown of the D'Arsonval type. The other terminals of the galvanometer coils, C₁, C₂, connect through adjustable resistances, XR₁, XR₂, and switches S₁, S₂, to their respective outside

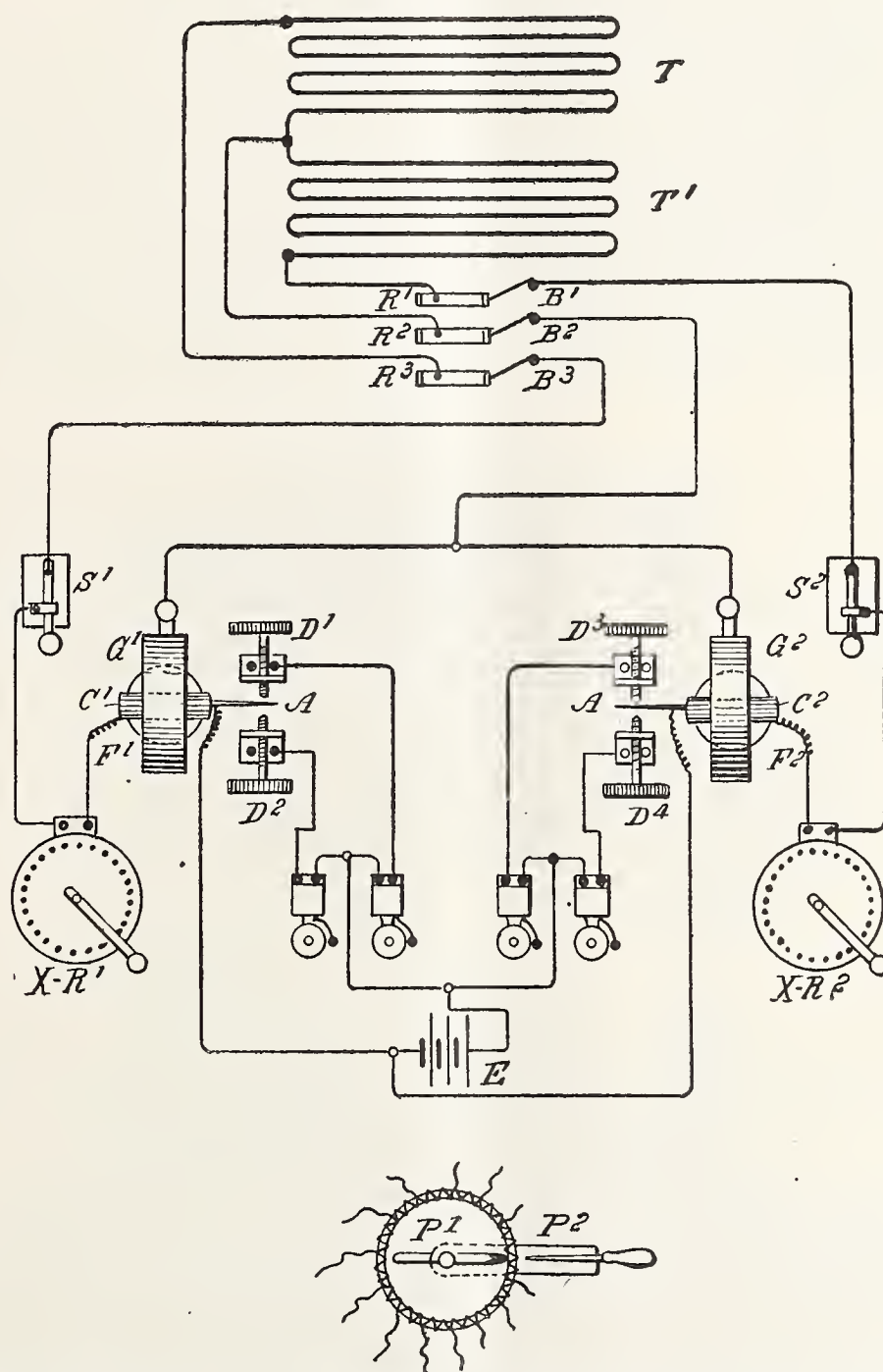
rings R_1 and R_2 . For observation a galvanometer scale may be employed, or perhaps an automatic indicating apparatus, as shown in Fig. IV. A light aluminum arm, A , fastened to the movable galvanometer coil, swings between two adjustable contacts, D_1 , D_2 or D_3 and D_4 ; a local circuit, including batteries E and bells, is completed should this arm turn through a small angle. For indicating the exact position of the thermopile a large number of contrivances may be constructed. In these it should be aimed at to have a position indicator P , operated by the same current which revolves the thermopiles.

Suppose now that in foggy weather, when we cannot see, when we are in fear of being deceived by the sound,

thermopiles by switch S_1 or S_2 , will immediately give us an approximate knowledge of the direction from which the vessel is approaching us. To obtain a more accurate knowledge, the adjustable resistance may now be manipulated; it being in circuit with the galvanometer, the current from the thermopile will of course be cut down. Under normal conditions, i. e., with the resistance cut out, the bell will operate for a certain length of time, depending upon the amount of radiations sent forth from the nearing vessel, as well as the time of exposure to their influence; this again depends upon the speed of the revolving thermopiles.

The purpose of the resistance, then, is to cut down the

FIG. 4.



The Herbert Apparatus for the Detection of Icebergs and Prevention of Collisions.

we start this apparatus and make ourselves independent of the watchfulness of other vessels.

A vessel approaches—we are not aware of it—the radiations given out by the same are too weak to affect the apparatus; we come nearer each other; a stronger current is set up in one of the thermopiles at the moment it points in the direction whence the radiations proceed. Instantaneously the galvanometer coil is slightly turned, the aluminum arm makes contact and causes one of the bells to give a short ring. This happens once at every half revolution, as then the second thermopile becomes active. As the distance between the vessels diminishes the effect will naturally increase, and a contact is made covering a longer period of time. Watching the position of the slowly moving position indicator P at the moment the bell rings, and simultaneously cutting out one of the

action of the thermopile to such extent that the aluminum arm makes contact only at the instant the maximum current is being produced. As this can occur only when the thermopile points directly towards the strange vessel, its position is immediately ascertained by simply moving the contact lever until the bell gives the shortest obtainable ring.

For all ordinary purposes the observation of the slowly moving position indicator arm P will therefore be sufficient. A small adjustable pointer P_2 , which may be swung around the outside casing of the position indicator, may serve to fix this position.

By the increased or diminished action of the thermopiles we know whether a vessel approaches or whether it recedes; by watching the position indicator, we know whether the vessel is moving toward the right or toward

the left. These means, therefore, enable us not only to ascertain the presence of a vessel, but also to follow its movements; and all this is accomplished by simply adjusting the rheostat, listening to the bell, and watching the position indicator.

Safely passing the vessel we now come near an iceberg. The effect is similar as before; the current produced is, however, now flowing in the opposite direction, causing the coil to turn the opposite way, and also a different bell to give its warning signal. It is possible, therefore, to tell the nature of the obstruction, whether it be a vessel or an iceberg.

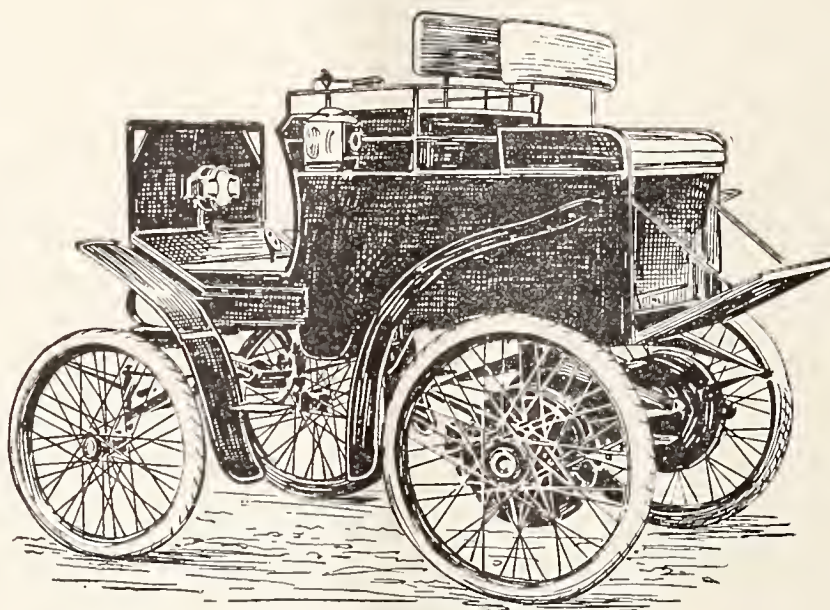
In the case of a floating wreck more difficulty is to be expected, as its temperature will not differ very much from that of the surrounding atmosphere. It may, however, be that if its entire exposed surface is in moist condition, a sufficient fall of temperature is produced to affect the apparatus, and to do likewise on account of radiations given out due to exposure to the rays of the sun. For the same reason it may also be possible to tell when nearing a coast.

The double thermopile is proposed for the purpose of increasing the action of the apparatus, as then it is possible to revolve the same at a slower speed, in that way giving a longer exposure to the radiations. At the same time the vessel is better protected. A combination of

use of, forming a bridge between the two electrodes which are in circuit with battery and telephone. In some experiments Graham Bell used a bottle or test tube, covered or filled with soot. Throwing the focussed light would on these produce a sound if the rays be of an intermittent nature.

It is a fact, then, that heat rays will affect the conductivity of such radiophonic apparatus. Whether their application to the above end could be accomplished seems at this moment difficult to answer. If their sensitiveness can be brought up to that of the thermopile, and if no serious mechanical difficulties be met in maintaining the soot on the proper place, then it would become a simple matter to apply such radiophonic apparatus for the purpose stated.

My first conception of applying these means dates back to July 7, 1898. I will not commit myself in stating that such methods as outlined above are absolutely feasible under all conditions; nevertheless they appear worthy of a careful perusal, study and experiment. Certainly a large number of factors must be dealt with in the attempt of solving the problem so fascinating, interesting, and what is more, of such vital importance. The effects of warm winds, those of the Gulf stream and perhaps many others, must be considered. A true guide to the vessels, whether in peace or in war, would be welcomed by all parties con-



Columbia Motor Carriage, Mark I.

four of these would undoubtedly improve the effects considerably, as the speed may then be cut down still lower. A plurality of thermopiles suitably arranged would not require to be revolved.

The indicating apparatus, i. e., the galvanometer, should preferably be mounted so as to be free from vibration, and in a similar manner as that employed with the compass, to make it independent of the ship's motion.

Now a few remarks touching upon the radiophone:

Berzelino, in 1817, discovered the silenium. Knox, in 1837, found that it was an electrical conductor. May discovered that its conductivity is much influenced by light. In their experiments most physicists used the galvanometer, while Bell used the telephone. Bell and Tainter subsequently constructed the photophone, its receiver consisting of metal disks insulated from each other and covered with selenium. A ray of light—reflected from a mirror diaphragm against which is spoken—after passing through suitable concentrating lenses is reflected to a distant parabolic concave mirror and thence unto a selenium cell, which is in circuit with a telephone receiver and battery. Sound was in this manner transmitted over a beam of light. Later experiments showed that sound can be transmitted more efficiently by non-luminous heat rays. Mercadier then constructed the radiophone. In this instrument soot or lamp-black is made

cerned. Not only that accidents and consequent deaths would be almost entirely eliminated as far as collisions are concerned, but also would such travelling lose its most detrimental danger.

Seeing all the possibilities, I most heartily advance these rather incomplete ideas, and hope that the Press here as well as abroad will contribute its share in discussing the subject. I also express the hope that all those interested will not withhold their ideas, and further, that influential parties will lend their aid to bring about a realization of this problem.

HERRMANN HERBERTS.

Newark, N. J.,
225, Washington Street,
July, 1898.

ELECTRIC AUTOMOBILES.

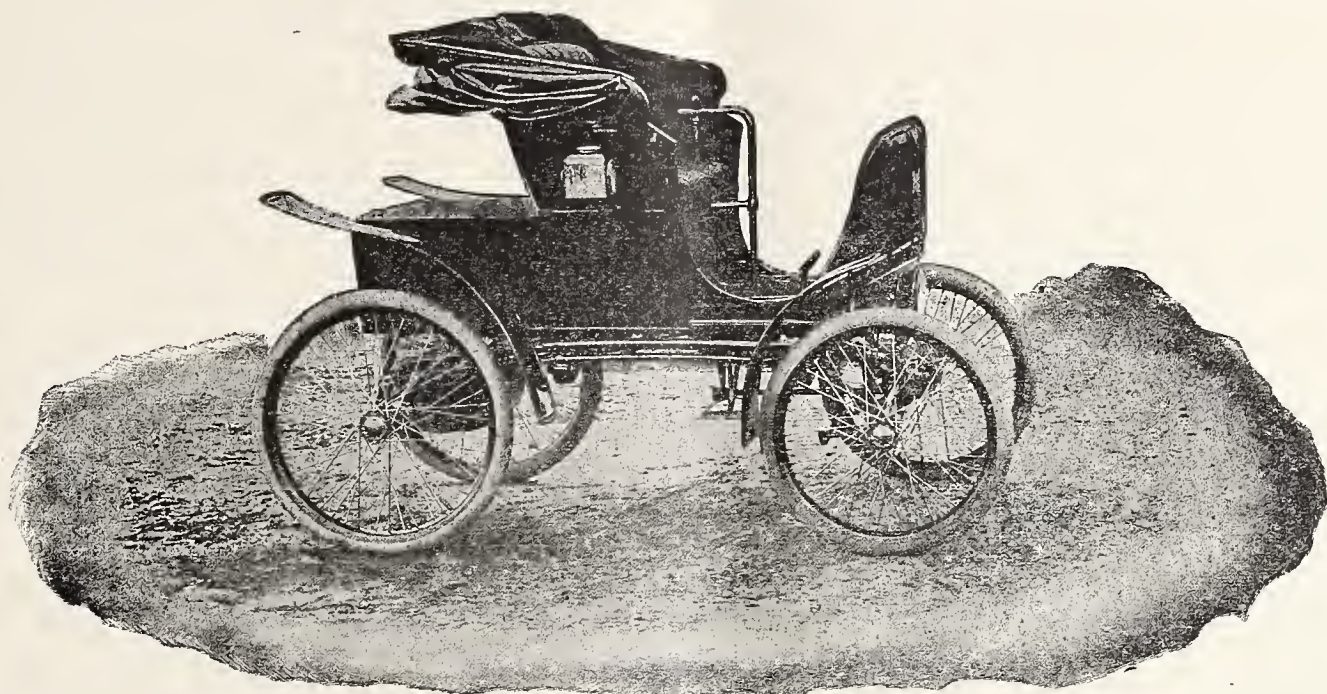
The great power of the future is undoubtedly electricity, and in its many phases and forms will be found in the factory and home, driving the wheels of great machines, running trunk lines, lighting and heating our cities and finally displacing the horse from its familiar position before the dashboard of the family carriage.

Stables of the old type, those of to-day, will be rehabilitated, absolutely transformed as it were, into an estab-

lishment equipped with every convenience for the preparation of the electric carriage for the road. In it electricity will reign supreme. Horses will no longer claim our attention for either fast driving or long distances, but in their place will be found a veritable Pegasus, an invisible and tireless giant, requiring neither whip nor reins, nothing but the touch of a button, a harness of insulated wire.

take about three hours to charge, and during that process require no further care than the attaching and detaching to and from the 110-volt circuit. One charging will carry the vehicle a distance of twenty-five miles. About five thousand trips may be made before the batteries give out, and the expense of a charge is about sixty cents. The illustration show types classed as Mark III., IV. and VI.

Mark III. carries a two-horse power motor as well as



Columbia Motor Carriage, Mark III.

The Pope Mfg. Co., of Hartford, Conn., exhibited at the recent Electrical Show one of these new carriages. As a paragon of excellence its superior qualities attracted considerable attention. We illustrate below types of the Columbia Electric Motor Carriage for the reader's benefit. It is, of course, interesting to know the answer to two most important questions—

(1st) Are electric carriages practical?

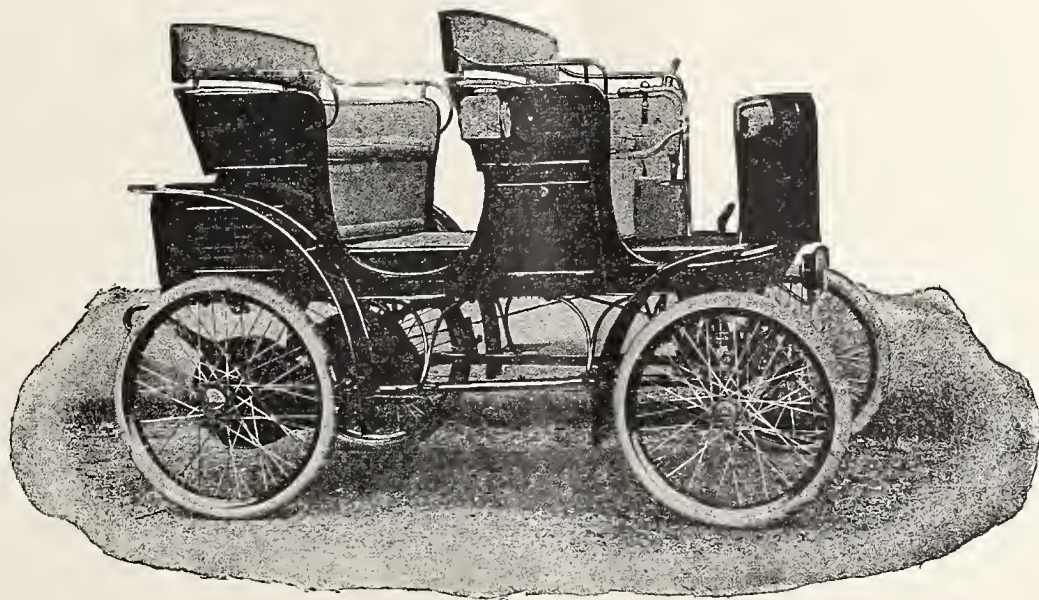
(2d) What is the cost of operating them?

To these questions may be evidently added others referring to the original cost of carriage, depreciation, weight, etc. As regards the practicability of the scheme

Mark VI. Mark IV. carries a pair of two-horse power motors so enclosed as to render them immune from dust or moisture.

With their three-inch pneumatic tires and solidly constructed wheels of high resilience as well as fine design, from an æsthetic standpoint the Columbia motor carriages are most emphatically reliable, practical and handsomely constructed.

As regards the cost of operation and wearability, they are factors that require no further discussion. The carriages themselves are priced as follows: Mark III., \$2,500; Mark IV., \$3,000, and Mark VI., \$2,750. The renewal



Columbia Motor Carriage, Mark IV.

of operating carriages by electricity our reader should interview a European traveller on the subject. Streets in Paris, London and Berlin are filled with automobiles. They are common sights and play their part there as a familiar feature of a permanent nature.

Their practicability is not doubted there, only the character of the power employed. In this respect electricity is by tacit admission the most satisfactory form of energy to be used. In the Columbia carriages storage batteries of the lightest weight commensurate with the supply of power and efficiency required are in use. They

of the storage battery in each costs as follows: for Mark III., \$375; Mark IV., \$525 and Mark VI., 425.

Comparing the horse and carriage with groom, etc., from a dollar-and-cent standpoint, with the horseless carriage, it will be seen that the above figures are comparatively low; that is, the original cost of a team of horses, carriage and their care, with the first cost of a Columbia Electric Motor Carriage complete, would balance up evenly, leaving a large margin in the purchaser's favor the second year.

THE MONTAUK MULTIPHASE CABLE.

[Extract from the Williamstown "Advertiser" of Saturday, July 2, 1898. Electric Fire Alarms. Some Startling Novelties, Introduced by Mr. E. H. Kirkby.]

Yesterday afternoon a number of leading gentlemen attended Mr. E. H. Kirkby's manufactory, Nelson Place, to witness some startling effects in electric mechanism either introduced into the colony from America by Mr. Kirkby, or the results of his own researches. The public of Williamstown may not be aware that Mr. Kirkby, in his own special line, is not only the leading machinist in Melbourne, but he perhaps has no equal in Australia. He does the electric alarm work for the Metropolitan Fire Brigade; has fitted up Government House, several of the large houses in Flinders Lane, the Princess Theatre, and his services have been sought to do similar important work in Sydney.

Mr. Kirkby yesterday astonished his visitors by the readiness of the various devices in his establishment to give fire alarms and to ring bells and telephone upon the slightest provocation. There would be a fortune for an illusionist show in some of this mechanism he uses. One of these is so sensitive to heat that, by merely breathing upon it, it will ring an alarm bell, but Mr. Kirkby explained that the temperature at which it worked could be regulated like the working of an alarm clock.

Mr. Kirkby has introduced the Montauk Multiphase Fire Cable into the Colony, and it was submitted to a

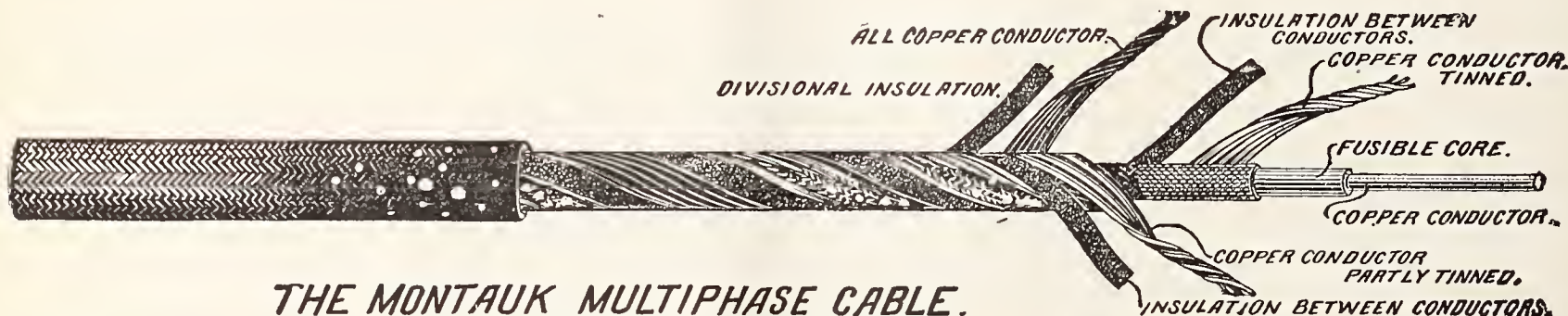
Welshbach should seek to develop some similar improvement for the application of electrical currents to illuminating purposes.

This he appears, from the somewhat meagre published accounts, to have found in a filament of osmium, one of the rare metals, which, besides being the densest of all metals, is the most refractory, being infusible at any except the highest attainable temperatures. Osmium is found native as an alloy in certain ores of platinum and iridium. It is a hard, bluish-gray metal, with an atomic weight of 191.1, and the enormous specific gravity of 22.477, the heaviest substance known. Its tetroxide has a strong odor of chlorine, from which circumstance its name was originally derived.

But the property which must have suggested osmium as the material of the new electrical filament was its practical infusibility, its known resistance to temperatures in which platinum and iridium volatilize and disappear. It is well known that the intensity of light emitted by an incandescent substance increases rapidly with its absolute temperature. By heating osmium in a vacuum with an electrical current strong enough to volatilize platinum, it attains a luminosity hitherto almost unknown, emitting a white light of agreeable quality and color, but of great intensity.

So far as can be inferred from what has been published, the experiments of Dr. von Welsbach go quite beyond the employment of a naked osmium filament, and include coating the metal with a refractory oxide like thoria.

It has long been known that a platinum wire or fila-



THE MONTAUK MULTIPHASE CABLE.

SHOWING FUSING EFFECT AFTER CONTACT WITH DANGEROUS HEAT OR FLAME.

highly satisfactory practical test for the first time in Australia yesterday. It is a most ingenious invention, and Mr. Kirkby is so satisfied with it that he has taken the responsibility of recommending it to Mr. Stein, superintendent of the Metropolitan Fire Brigade, and will introduce it to the big mercantile houses in the city. The cable can be attached to an ordinary electric bell, to a telephone and to the fire alarm. The great and peculiar property possessed by this cable is that when it is ignited it will instantly ring a fire alarm on any premises where Mr. Kirkby's automatic fire alarm is connected with it. Mr. Kirkby is convinced that if this cable had been used in Melbourne recently the great fire, at which damage to the amount of one million sterling was done, would have been avoided.

Mr. Kirkby intends to give another demonstration in the city at an early date.

A NEW INCANDESCENT FILAMENT FOR ELECTRIC LIGHTS.

The German Journal for Gas Lighting of recent date contains some highly interesting information upon what is perhaps the most important new topic in the science of illumination, namely, the improved incandescent filament for electric lamps, which has just been announced by Dr. Auer Von Welsbach, the distinguished inventor of the incandescent gaslight which bears his name. It was but natural that, having perfected the device which increases so remarkably the illuminating power of gas, Dr. von

ment, through which a sufficiently strong current is passed, attains a white heat and then suddenly melts. If, however, the filament be coated with a highly refractory oxide like thoria, the temperature required to melt it is greatly increased, for the reason that part of the electrical energy is withdrawn from the metal to its oxide coating and is radiated in the forms of light and heat. Precisely the same result happens when the filament coated with oxide is of osmium, instead of platinum, and the resistance of the filament is still further increased to the extent that osmium is in itself more infusible than platinum.

There is thus obtained a filament capable of sustaining a temperature and consequent intensity of illumination hitherto unachieved by such means, and it is this which forms the germ of the present invention of Dr. von Welsbach. It has been noted in his experiments that osmium used for this purpose must be almost chemically pure, and that commercial forms of that rare and costly metal require, before using, to be cleansed, as far as possible of all impurities except platinum, a small admixture of which renders the osmium more elastic without sensibly diminishing its infusibility. The whole effect of the invention, if practically applied, will be to advance in an important degree the limit of electrical energy which may be used in incandescent lighting and thus reach a new standard of economy in the production of artificial light, which is cheapest at the intensity obtainable only at high temperatures.

Osmium, according to the trade catalogue of a leading German chemist, costs \$1.10 for twenty grains; so that if

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THE NATURE OF OZONE.

Ozone is a gas possessing remarkable properties. It has received attention from the greatest of our scientists and is considered by them as the most powerful oxidizing agent in existence.

The great investigator, Michael Faraday, pursued a variety of experiments with ozone, which made him in turn conclude, to use his language, "It is a powerful electromotive substance." The molecule of ozone differs from that of oxygen in being composed of a triad of oxygen atoms instead of merely two. The influence of a high potential or a powerful electrostatic stress on a stream of pure oxygen will alter the atomic combination sufficiently to transform a considerable portion into ozone.

The properties of ozone are certainly remarkable when we realize that it is essentially oxygen, and yet differs so radically from oxygen in the possession of new chemical characteristics. It seems to be oxygen compressed, as it were, and thereby developing the reactive powers from which it has derived its name. We may present as a direct proof of the effect of a force in transforming oxygen into ozone that, during this transformation, energy in the form of heat is absorbed, to such an extent that nearly 30,000 calories disappear in the production of about fifty parts of ozone.

Regarding the manufacture of ozone, from a technical standpoint, we discover that a glow or brush discharge is most effective in producing this gas. Experiments carried out with the idea of determining why atmospheric oxygen undergoes transformation have resulted in the conclusion that an electric discharge so raises the temperature of the oxygen that the transformation of it into ozone immediately ensues.

Whatever may be the nature of the new chemical re-

combination which occurs, ozone still remains one of the most unique gases in existence. Its hygienic value and bleaching properties are familiar to all, though not known with any degree of definiteness. A slight percentage of it in the air possesses the greatest medicinal value, stimulating the lungs and increasing the strength and beat of the pulse.

As a disinfectant it acts with remarkable power, completely annihilating active, poisonous and disease-spreading germs. For the prevention of suppuration in wounds, and the treatment of ulcers, etc., ozone has been found to be an excellent medicament.

It is surprising to realize how frequently and effectively ozone becomes of use in large cities. Of course its value is greater in the field of medicine than when applied commercially, but in either case it is generally admitted that ozone is one of the most valuable additions to the list of useful discoveries. A decided advantage in its favor is due to the fact that it may be readily manufactured even in homes or places removed from electric light wires. The exceedingly beneficial effects of ozone lead us to presume that its use will greatly increase as the field of its application enlarges. The demand for ozone has grown to such an extent that a large English corporation have undertaken to supply physicians and the commercial world with apparatus for its generation.

At present it seems as though the manufacture of carbolic acid, peroxide of hydrogen, etc., were not of more immediate importance than the manufacture of ozone. One quality which it possesses, and which should lead to its immediate adoption by municipal authorities, is the readiness with which it sterilizes water. If used for no other purpose its power of rendering a contaminated water supply harmless to the innocent residents of a large city is sufficient.

We have lived up to a period of civilization in which we realize that the preying parasite, the mighty micro-organism, is known to have swept millions of the human race into oblivion.

Greater battles are now fought between men and microbe than graced the achievement of the Roman Cæsars. The physician is doing his work bravely, but the success of his efforts depends more and more upon the assistance of his readiest helpmate, the electrician.

PREVENTING COLLISIONS AT SEA.

To be clairvoyant to the approach of a vessel at sea is within the scope of an electrician's power. Recent accidents have shown the pressing necessity for some means whereby the captain of an ocean liner is in touch with objects around him. The dark nights, the foggy days, the snow-crowned icebergs looming suddenly up before him, have taught their lesson to the most careful of navigators. The day is approaching when the terror of such things will depart.

The article by Herman Herbert found in our columns, contains practical suggestions to this effect. We advise our friends to read it. The inventor of a successful scheme meeting immediate application will certainly benefit the human race as much as the unknown discoverer of the compass needle. Mr. Herbert's article indicates a close study of the situation, but as to its success, that can only be determined by trial. Even if unsuccessful, at times a device that will assist us in warding off that most awful of dangers, a collision at sea, is worthy of the most serious consideration, and its originator should be blessed for his intentions as well as his success.

Victoria, B. C.—The British Columbia Electric Railway Co. have asked for an extension for two years of the time for the completion of their railway.

the new filament should become successful in general use, there will be a demand for a larger supply of that metal at a more moderate price.

FRANK H. MASON,
Frankfort, July 5, 1898. Consul-General.

ELECTRIC WELDING, FORGING AND HEATING.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

One of the most familiar effects of the electric current is the production of heat. The light of the incandescent lamp depends upon the heat for its degree of brilliancy. The arc lamp only reaches a point of sun-like brightness when the heat of the arc intensifies with increased cur-

Carbon becomes a plastic mass; the diamond, a bit of ash.

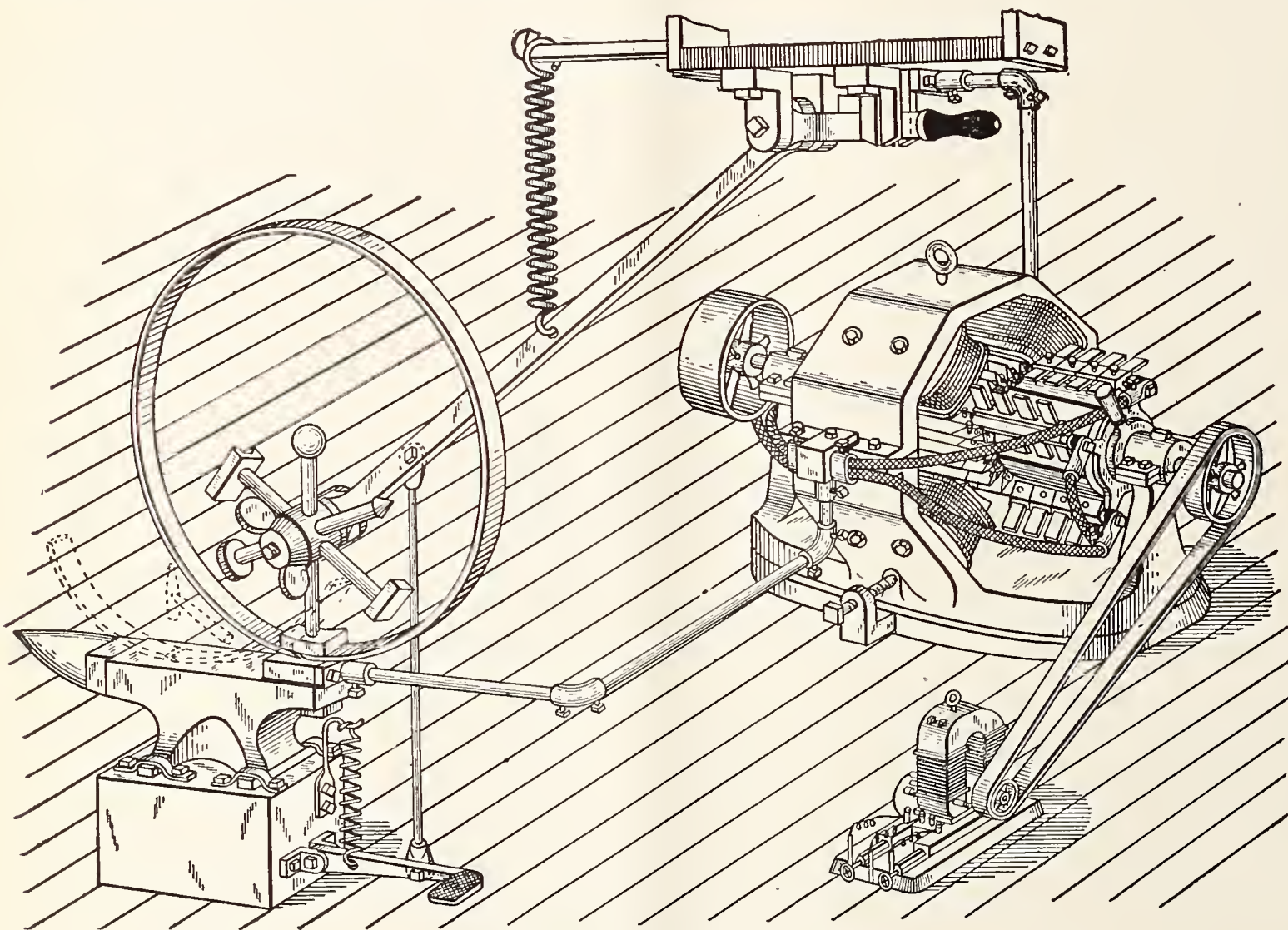
Welding by electricity depends entirely upon the heat produced by the imperfect contact between two pieces of metal. The resistance of the joint causes the heat to localize itself there until the ends in contact become semi-liquefied and ready for permanent junction.

Steel, copper and iron are generally employed for the illustration of this process. The current used is alternating, being transformed down to a few volts when used.

The Thomson Electric Welding Co. have completed machines for practical use which will weld pieces of metal of given cross-section.

One size of welder will successfully join pieces of three square inches in cross-section; the smaller size can weld 1.2 square inches; also welders for the joining of pipe six inches in diameter are manufactured.

The object in view when welding is attempted should be



Electric Forging by the Burton Process.

rent. The production of heat in an electric circuit can be controlled and reduced so as to be either imperceptible or too great to bear with hand or eye.

In any electric circuit the heat evolved is calculated by the rule—

$$\text{Heat} = C \times C \times R = \text{watts.}$$

Thus the power consumed in producing heat in a circuit having

$$\text{Resistance} = 10 \text{ ohms.}$$

$$\text{Current} = 10 \text{ amperes.}$$

$$\text{Watts} = 10 \times 10 \times 10 = 1,000.$$

An amount of energy exceeding one horse-power would be absorbed under these conditions.

To apply sufficient heat to a piece of metal to melt it requires a volume of current dependent upon its resistance. The greatest heat we have had actual experience with, is that of the electric arc. All the metals, oxides, quartz and granite formations become volatilized in it.

Sufficient pressure at joint.

Sufficient current.

No oxidation.

The current used for the purpose is generated in an alternator at about 300 volts pressure; it is then transformed down to from 3 to 12 volts, according to the nature of the work to be done.

Many experiments have proven an alternating current the best for welding purposes. The positive pole of an attempted weld with continuous current would be very much hotter than the negative. This would seriously interfere with the weld, while if an alternating current be used the current heats each end equally. If a slight oxidation occurs at the joint, the weld may bind at the edges but be perfectly insecure inside. The instant the heat has arrived at the right point, the two bars of metal must be pressed together as forcibly as possible. This creates a burr on the outside which may be hammered down flush with the rest or removed in the lathe. The

resulting surface should be smooth, unseamed and continuous when finished, without any signs of the juncture visible.

When steel is welded it sometimes happens that a black, burnt-looking mass forms at the welded point. This is caused by overheating, which drives out the carbon and changes the nature of the metal.

It can be restored by resting in a bed of red charcoal until carbon has been reabsorbed.

If a pail filled with a solution of soda or sal ammoniac and water have a metal plate connected to an insulated wire placed at the bottom, any piece of metal connected to another wire will, when dipped, become rapidly white hot *in the water*; the two wires being connected to a source of current. If one wire is disconnected, the same water serves to cool the metal instead.

Blacksmiths in the neighborhood of Niagara Falls use current from the trolley roads for this purpose, their forge consisting of a pail of water and a pair of insulated tongs.

For purposes of forging, the following figures are given for an 80-lb. bar measuring $1 \times 8 \times 36$ inches.†

Use 220, 250 or 500 volt, direct current.

Set forge level and on a dry floor.

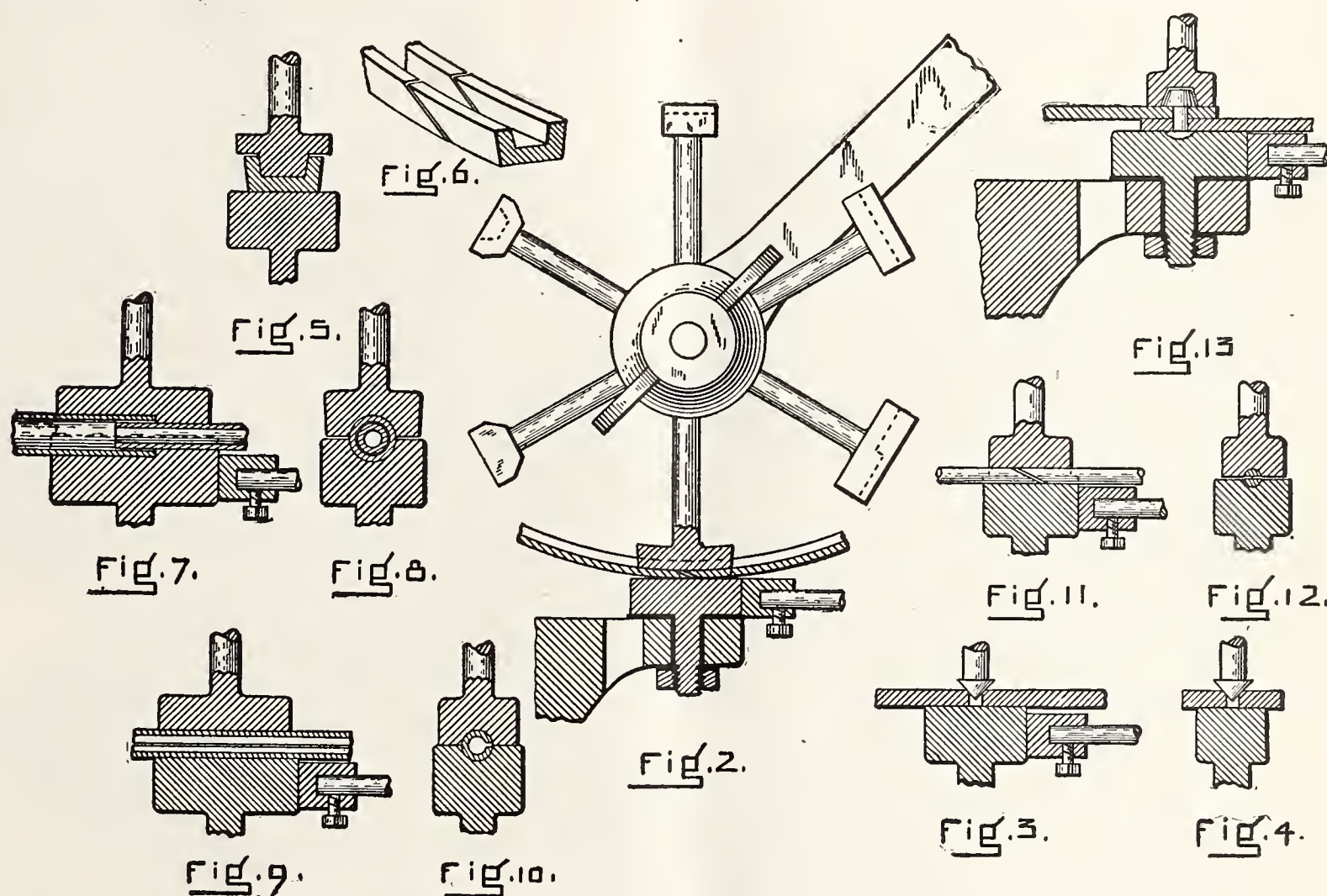
Always connect negative pole to the iron bar on the edge of tank, or there will be no heating effect. Connect positive pole to the wire extending outside the tank.

Fill main tank with water to within $1\frac{1}{2}$ inches from the top. Add 10 lbs. sal-soda and 2 lbs. salt, if 220 or 250-volt current is used, and only 5 lbs. sal-soda and 1 lb. salt, if 500-volt current is used. Whenever the solution becomes too strong and the heat is too rapid, take out two or more pails of water, and add same amount of fresh water.

Use a switch when connecting up between main supply and the tank. Leave switch open when not in constant use.

The forge will heat any metal from a number 40 wire to a bar $1\frac{1}{4}$ inches diameter, and from $\frac{1}{2}$ to 15 inches long.

Current in amperes varies from 0 to 65 amperes, according to the size of piece heating, the piece itself determining the amount of amperes and acting as a natural



Sketches of parts of Burton Electric Forge.

Cost of heating by coal,	\$1.25
" " " " electricity,	0.78
Saving,	\$0.47

The advantages of an electric forge are therefore not merely those of convenience alone, but to be figured in dollars and cents.

The Burton Electric Smelting Company manufacture machines shown in illustrations. Mr. George D. Burton developed the process by means of which a receptacle or tank of some suitable insulating material holding aqueous solution of sodium carbonate and borax can be used for heating a metal uniformly throughout its mass. The qualities of this electric forge and its remarkable simplicity make it applicable to all kinds of forge work. We append directions for using Burton's electric forge, which will be of great interest to our readers:

Directions for Using Burton's Electric Forge.

regulator. It is best to fuse up the connections with 50 ampere fuses on 500 volts, or heavier on lower potential circuit. When the forge is ready for operation, rest the metal to be heated on the iron bar or circuit negative pole at edge of tank, always resting the metal to be heated first on the bar, then bring it into contact with the solution. If the solution is touched first, the heating arc will be formed on the supporting bar instead of in the solution. To heat a bar in the middle for a given space, rest it on the small bar near the diamond-shaped tile, the portion to be heated resting across the tile; the tile to be filled with the solution and kept overflowing from the spigot during the heating operation.

If the heat is found to be too intense or too rapid, take out a portion of solution and add water; if too mild, add a small quantity of table-salt from $\frac{1}{4}$ to $\frac{1}{2}$ lb. Always open switch before making any change in the solution; the liquid should stand four hours before using when tank is first filled. By use, the liquid will evaporate slightly; add water when required, so that the tank shall be kept full.

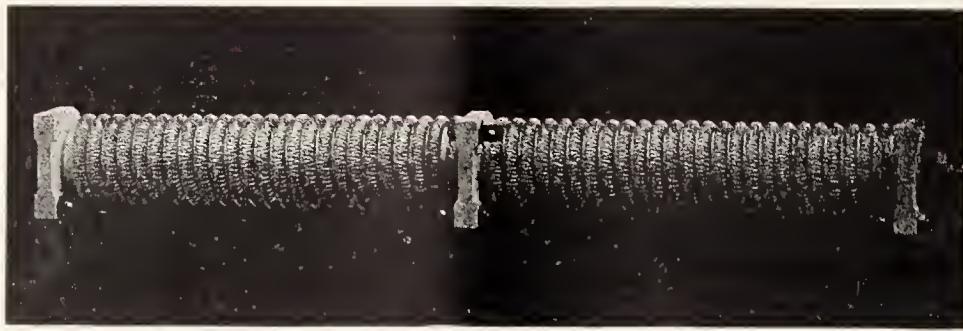
The Electric Forge is protected by U. S. Letters Patent issued to Geo. D. Burton.

For further information, address

Burton Electric Smelting Co.,

144 Lincoln Street, Boston, Mass.

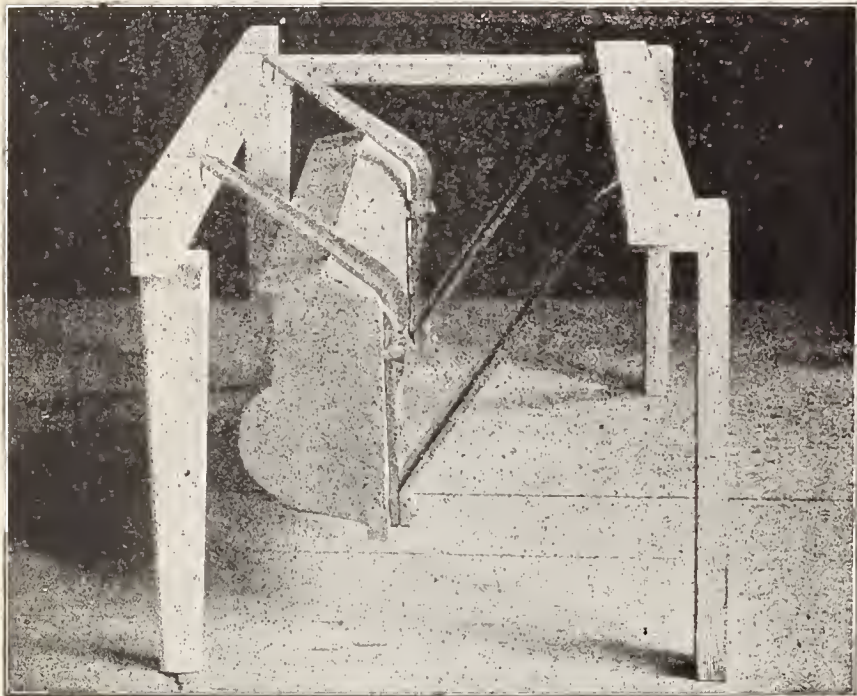
- (3) What are the requirements of a successful weld?
 - (4) How is forging done by electricity?
 - (5) Is electric forging or welding a commercial success?
- † [Electricity at World's Columbian Exposition.]



Section of Standard Heater, No. 103S, showing two short resistance coils.

Caution.—Always turn off current when not in constant use.

To avoid shocks never put one hand in the solution and the other on the bar or negative pole, nor one hand on the bar or negative pole and the other on the pump.



Method of Hanging No. 115K or 115S Heaters.

These requirements must be strictly observed and all danger from shock is avoided.



Heater No. 118 under Seat.



Standard Cross Seat Heater. One Short Resistance Coil.
Heater No. 88C.



Standare Cross Seat Heater. One Short Resistance Coil.
Heater No. 118.

QUESTIONS FOR REVIEW.

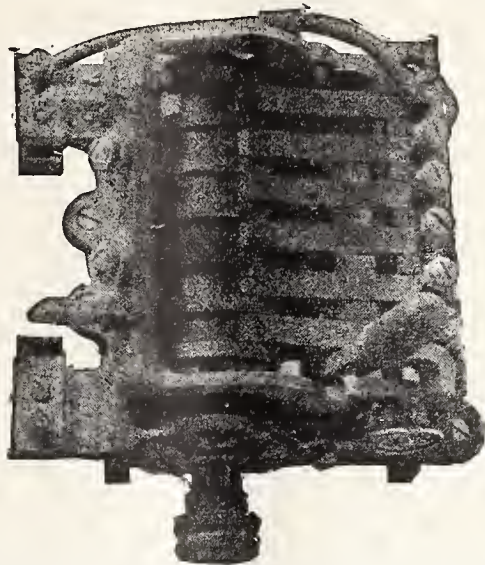
- (1) How is the amount of heat in an electric circuit calculated?
- (2) Upon what conditions does electrical welding depend?

ELECTRIC HEATERS AND TEMPERATURE REGULATING SWITCHES.

The passage of a current through a wire causes a rise in temperature dependent upon the resistance and square of the current. The energy dissipated is measured in

watts, and the temperature is controlled by the radiating surface of the heated body. The heating or warming of apartments, cars, etc., by electricity is accomplished in a

by The Consolidated Car Heating Co., of Albany, N. Y., which are in popular use by more than 250 railway corporations in this country.



Fire Intensity Temperature Regulating Switch.

very simple manner. A spiral of wire wound spirally around a fire-proof and non-conducting cylinder is enclosed within a metal framework, as illustrated in this article, and through the wire a current is sent and regu-

Two standard resistance coils are used by the Consolidated Car Heating Co. in the construction of their electric heaters. They are the long resistance coil, which cannot be used on a 500-volt circuit unless there are two in

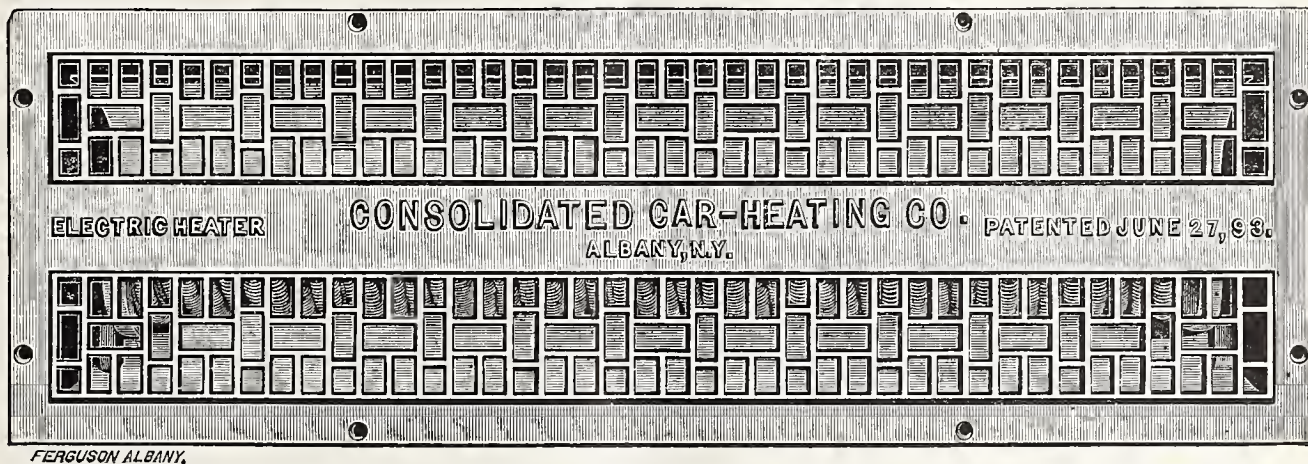


Two Short Resistance Coils Connected in Series. Heater No. 93 or 93S.

lated by the turn of a switch. The application of this simple principle is one which possesses the highest efficiency.

The technical student will readily understand why the electric heater is an ideal machine. If 100 watts passes

series, in which case the two coils consume four amperes, or a maximum of 1,000 watts per coil; and the standard short resistance coil, which has a resistance equal to one-half that of the long coil. This coil cannot be used with less than four in series, on a 500-volt circuit, in which case the



One Long Resistance Coil used with Switch No. 94. Standard Heater No 103S or 103T in panel.

through a heater of this description, heat equivalent to 100 watts will be radiated; in other words, the most economical way to produce heat is by the use of electricity.

The increasing demand for private installations and electric lights and power throughout all large cities has

four coils consume four amperes or a maximum of 500 volts per coil. With the long resistance coil the minimum consumption of current at 500 volts pressure with switch number 94 is 210 watts per coil. With the standard short resistance coil the minimum consumption of current



One Long Resistance Coil. Heater No. 115K or 115S.

had its influence in developing a large and growing trade in electric heaters. An appreciation of this fact has brought upon the market electric heaters manufactured

at 500 volts pressure with switch number 127 is 180 watts per coil.

The various styles of heaters shown in this article

have been almost exclusively used by the largest electric roads in the United States. More than 60,000 coils are in use today, and we find that in our own city the Metropolitan Street Railway Co. make use of them.

The ingenious arrangement by means of which the Consolidated Car Heating Co. can make whatever combinations they desire with their long resistance coil and standard short resistance coil is highly commendable. The amount of heat or current consumption is regulated between its highest and lowest points by means of regulating switches. These in connection with the coils provide a most convenient means of raising or lowering the temperature. A temperature regulating switch is shown among the illustrations. This is used with standard heater equipments. The current consumed on a 500-volt circuit is controlled from 2 to 3, 6, 8 and 12 amperes on switch positions 1 to 5 respectively. With heaters carrying more current control is exercised from 2 to 4, 8, 12 and 16 amperes at the same positions with the same switch.

Switch No. 94 and another not shown, No. 127, are used to control other combinations of heaters besides the standard arrangements given, especially with elevated car equipments. Both can be used to control house heating equipments, but are not recommended on circuits of less than 500 volts pressure. The Consolidated Car Heating Co. place the switches in black japanned iron boxes, $8 \times 8 \frac{1}{2} \times 3 \frac{7}{8}$ inches. For concerns or individuals requiring special resistance coils, other designs will be constructed satisfactory to the purchaser.

We conclude by saying that out of 60,000 coils built by this company, and in daily use, not one has failed in five seasons' service. The Consolidated Car Heating Co. may be communicated with at Albany, New York, or at 514 Western Union Building, Chicago, Ill., and Coaticook, P. Q., Can.

THE DEVELOPMENT OF THE CENTRAL STATIONS.

(Continued from Page 82.)

The public interest aroused in his work and the controversy as to whether it was possible for him to achieve anything that would be of commercial value is evidenced by the constant reference to the matter in the public press in 1878, 1879, and 1880, resulting in a panic in gas securities in London in 1878 and in New York in 1879. Probably the work of no inventor was more generally discussed on both sides of the Atlantic by laymen and technical authorities alike than was that of Mr. Edison on his electric lighting and power system. All kinds of comparisons were made as to the difference between the cost of gas and the cost of electricity. It was claimed by many that Mr. Edison could not possibly be considered as having succeeded in his work unless he could produce an illuminant that would compete commercially with gas. They lost sight of the fact that the characters of the two illuminants were entirely different, and that there was no more reason for supposing that, if electricity were more expensive than gas, the cost would be a barrier to its use any more than there is reason for supposing that gas should be considered a commercial failure because the poorest classes find it cheaper to use tallow dips. The probable reason for scientists and electricians doubting the possibility of a successful electric-lighting system being produced was that all previous experimenting on incandescent lamps had been, as I have already stated, aiming at producing a lamp of the lowest possible resistance and consequently requiring the greatest possible amount of current, these lamps being run in series, whereas Mr. Edison, at a comparatively early state of his work, realized that the first essential was a lamp of high resistance, and that the only way of approximating an even distribution of pressure was to run these lamps

in multiple arc. Hence his application for a patent on a lamp with a high resistance filament, under date of November 4, 1879, and his application on multiple arc distribution in February, 1880. It was then but a short time before he realized that, although experimentally this might give him even pressure, the expense of the copper in his distribution system would be too great, owing to the necessity of increasing the size of his copper as he got farther and farther from the point of generation. The result was that in August, 1880, he applied for his patent on a system of feeders to supply his system of mains at various points throughout the system, the effect being a compact system with current flowing in all directions from the central point of generation through feeders, by means of which even pressure could be maintained throughout a considerable area.

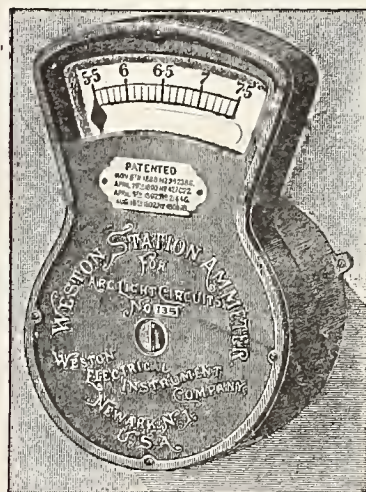
A still further step made by Mr. Edison was the realization that nothing very reliable in the way of a distribution system in large cities could be maintained unless the work was placed underground, and, as a result of his work of a little over two years we find that, in the early winter of 1880, Edison had a central station system experimentally at work at Menlo Park, N. J., having an underground two-wire system, with the homes of himself and his staff electrically illumined by incandescent lamps, motors at work in his laboratory, and, in fact, all of the essential features of what is to-day now so common from the largest cities to the smallest villages throughout the civilized world.

It was but a short time after the starting of the first central station, in New York, that Mr. Edison found himself looking for some more economical methods of distribution; and I well remember his first experiments on the three-wire system, when, at his shop in Goerck street, New York, he placed a third brush on the neutral point of the commutator of a small bi-polar Edison dynamo and demonstrated the practicability of the three-wire system.

At the same time that Edison was working on the three-wire system experimentally in New York, Dr. John Hopkinson was probably figuring out the same thing in England, and Werner von Siemens was engaged in similar work in Germany. The records of the United States, English and German patent offices bear witness to the fact that these three men accomplished about the same results at about the same time, and, as a consequence, between 60 and 70 per cent. of the investment in copper was saved.

(To be continued.)

Hamilton, Ont.—The annual meeting of the shareholders of the Hamilton, Chedoke and Ancaster Electric Railway was held last Saturday. It was stated that \$30,000 of the stocks had been disposed of, and that the construction of the road would begin at an early date.



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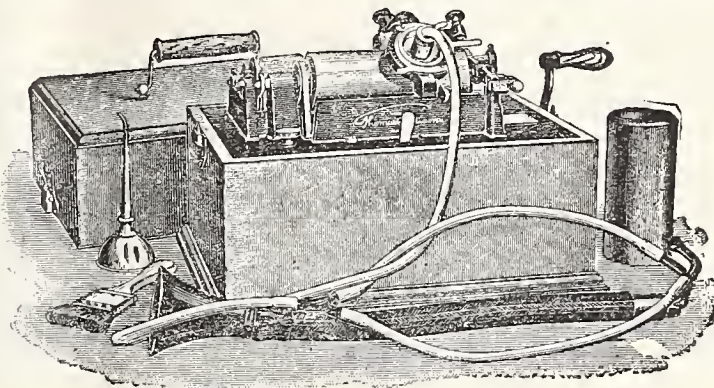
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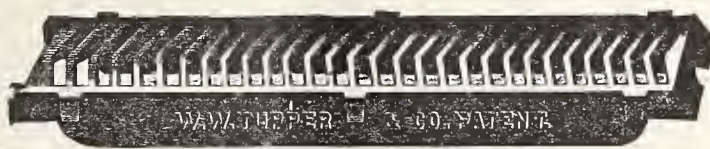


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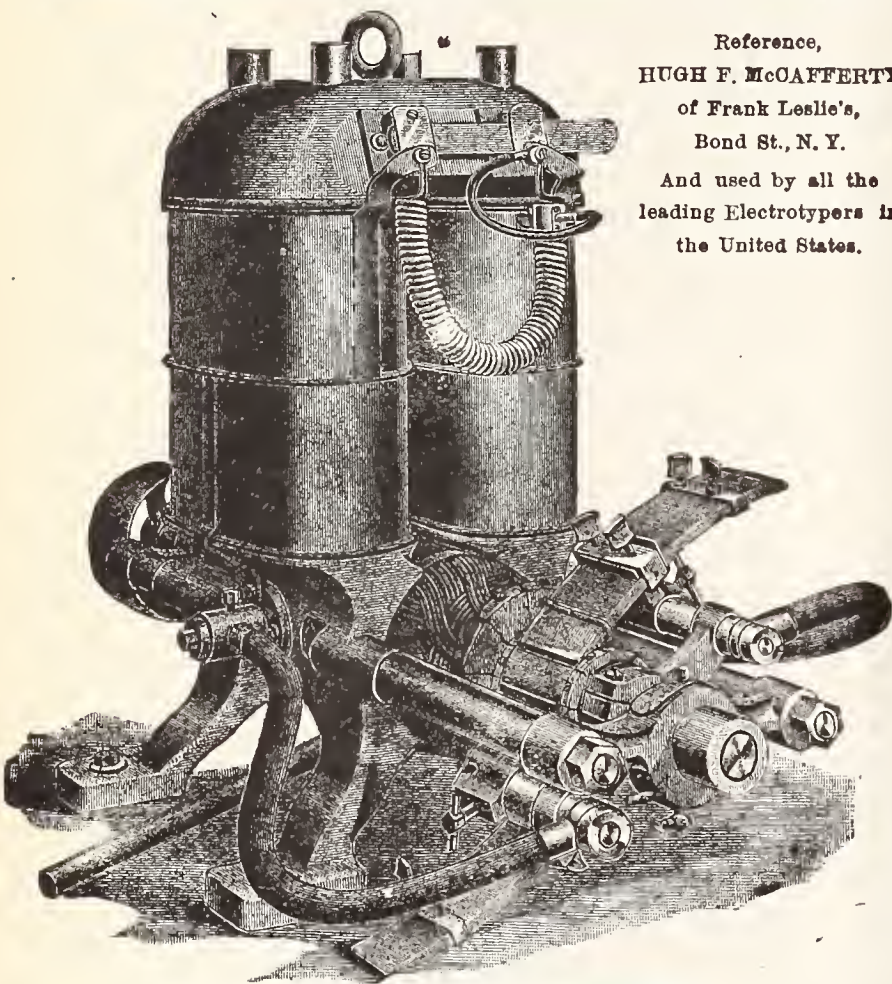
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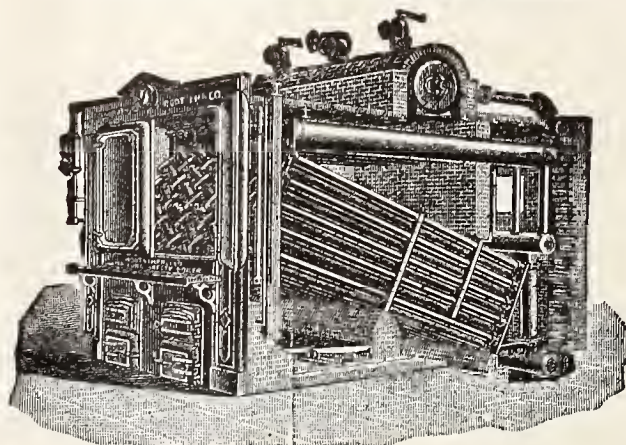
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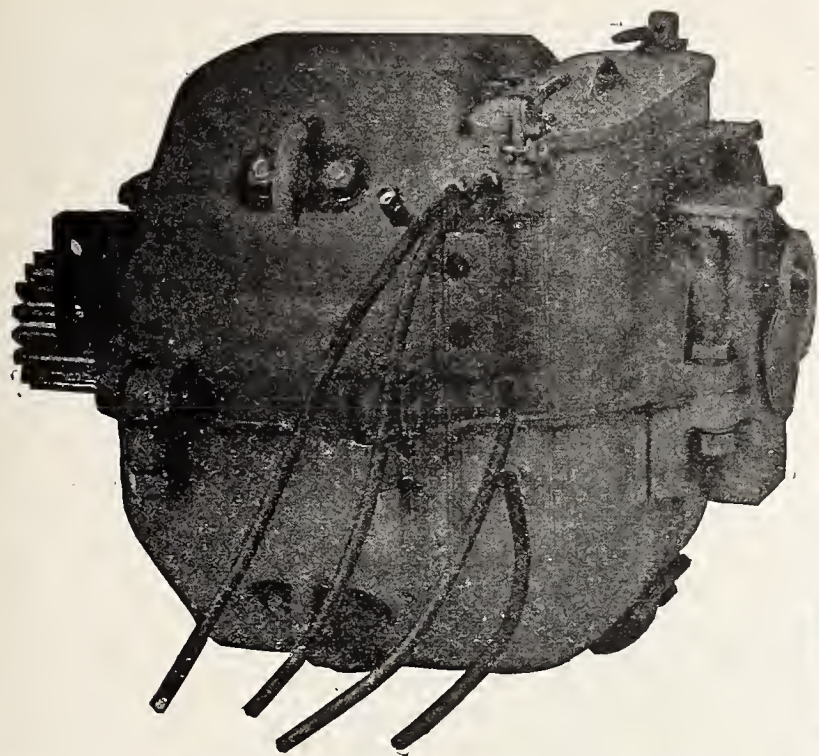


Fig. 1.—G E Narrow-Gauge Electric Motor—Front End.

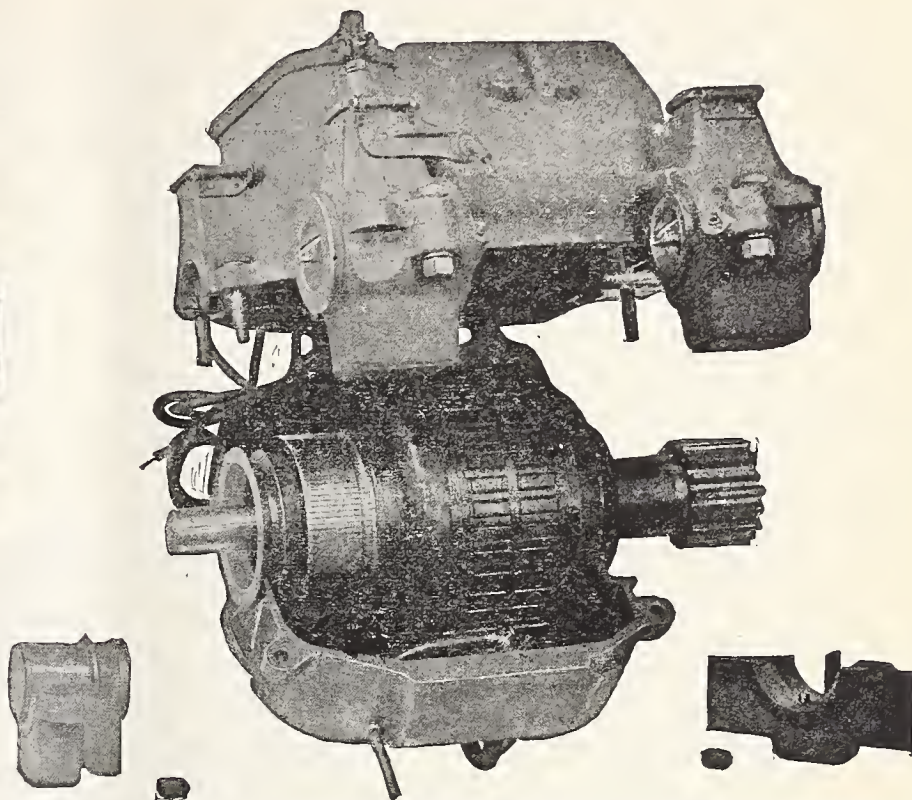


Fig. 2.—Lower Frame Dropped, Showing Armature Ready for Removal.

NARROW GAUGE ELECTRIC MOTORS.

The operation of a narrow gauge road demands a railway motor occupying a more restricted space than the motor built for standard gauge roads, while giving the same power. The General Electric Company has manufactured narrow gauge motors for some time past, and many are in actual service, giving the same high degree of satisfaction as the other types of the G. E. standard gauge motors. One type of narrow gauge motor now built is the G. E. 58, which resembles in outer appearance the standard gauge motor, and has an output of 37 H. P. based on the standard General Electric rating, i. e., a maximum rise of 75° centigrade in the temperature of the windings after a run of one hour at rated load, the temperature of the surrounding air not exceeding 25° C. This motor is built for comparatively heavy service, in which the G. E. 52 motor would be too light, and is especially desirable in cases of combined city and inter-urban service with moderately high speeds and heavy traffic. While designed for a minimum gauge of one metre (39 1-4 inches), the G. E. 58 may be used with wider gauge roads.

Magnet Frame.

The magnet frame is made of soft steel of high magnetic permeability, cast in two bowl-shaped halves. The frame is divided in a horizontal plane, and the two parts, when bolted together, completely enclose and protect the armature, commutator, brush-holders and field coils. Extension pieces are cast on the top at each end and extend over and partly enclose the car axle. To the under side of these extension pieces are bolted the axle-bearing caps, bored out to support and enclose the axle linings. The armature supports are made by bolting the bearing caps to the under side of the top frame at each end and boring them to receive the linings. The bottom frame is secured to the top frame by bolts, so hinged that when the rear bolts are removed the lower frame will swing down, exposing the armature and field coils for inspection and cleaning. In this position the bottom of field coils may be easily taken out, while by removing the armature

caps and the bottom half of the gear case, the armature and top field coils may be easily removed.

A large opening is provided in the top frame just over the commutator, through which the commutator, brush-holders and brushes can be inspected and worn-out brushes replaced. Through the same opening it is possible to remove the brush-holder yoke and brush-holder bodies. A malleable iron cover is securely held in place over this opening by an adjustable cam-locking device and is easily and quickly removed. A hand hole fitted with a gasket and cover plate is provided in the bottom frame directly under the commutator, permitting easy access to the bottom of the motor for inspection and removal of foreign substances.

Bearings.

Appreciating that the renewal of linings is frequently the principal item of maintenance cost of a motor, particularly when designed within the limitations of narrow gauge, much attention has been given to the design of the linings and the bearings. The armature bearing linings are made of machined cast iron with 3-16" Babbitt metal swaged hard and bored to the proper size to fit the shaft. The bearing of the commutator end is 2 5-8x6 5-16", and on the pinion end 3x7 7-8". The supports for the linings are constructed on the outboard plan, which renders the bearings easily accessible and prevents oil or grease from working into the motor frame. The support for the upper half of the armature shaft lining is cast as a part of the upper half of the frame and is provided with a large cored recess between the inner end of the lining and motor frame. This space is utilized for a thrust collar, so designed that its outer edge acts as an oil guard and turns in the recess between the motor frame and the bearings. The support for the lower half of the lining is a cap bolted to the upper frame, in such a way as not to enclose the lower half of the oil guard, thus allowing free egress for the lubricant after it has passed through the bearing. The axle bearing linings are similar to the armature bearing linings and are 8" in length and of the re-

quired diameter to fit the car axle. The upper supports for these linings are cast with the upper frame; the lower supports are caps bolted to the upper support.

All bearings on the motor are provided with grease boxes and oil cellars of sufficient capacity for thorough lubrication. The grease boxes are cast with the upper frame and are covered with flanged lids held down by springs to exclude the dust and dirt. Oil cellars of ample capacity are provided in the bearing caps. The oil is fed by felt wicks or wipers, which come in contact with the shaft through holes cut in the linings.

Field Coils.

The motor has four field coils, two in each frame, placed at an angle of 45° from the split, and held in place by pressed steel flanges, or spool holders, clamped by projections on the laminated pole pieces. The pole pieces are held in place by through bolts with nuts on the outside of the frame, the coils being placed in position when the pole pieces are bolted to the frame. The field coils are wound with round wire insulated with asbestos, and are substantially insulated over all with wrappings of varnished cloth and tape. The insulation between field coils and motor frame is tested by 5,000 volts alternating—sufficient to thoroughly prove the quality of the insulation. The field-coils leads are brought out through the frame in a convenient manner for connecting to the car wiring, and it is not necessary to disconnect any leads inside of the motor frame when dropping the lower half for cleaning.

Armature.

The armature is of the well-known iron-clad type and is $14\ 1\text{--}2''$ in diameter with a spread of $6\ 1\text{--}2''$. The core is built up of well annealed laminations and is assembled directly on the shaft. There are 33 slots, and each slot contains three coils, collected together and insulated so as to form one triple coil. Hence there are 33 triple coils connected with 88 commutator bars. A small number of coils is of especial advantage when an armature has to be repaired, and the method of forming the coils into groups of three admits of substantial insulation of high quality. The insulation of the coils consists of specially prepared tape and cloth, which has high insulating qualities and is impervious to moisture. When the coils are in place on the armature core they will withstand without injury a high potential test of 2,500 volts between the windings and the core.

The terminals of each coil are brought directly into the commutator segments and soldered so as to properly connect the armature coils, and at the same time form the connections between the armature windings and the commutator. The end windings are effectually protected from mechanical injury and carbon dust by the metal core heads and by a canvas dressing. The coils are held in place in the slots and on the ends by tinned steel wire bands, held together by clips and securely soldered.

Commutator and Brush-Holders.

The commutator is $10''$ in diameter. Its segments are $4\ 3\text{--}8''$ long, with a wearing depth of $1''$, and are insulated from the shell by cone-clamping insulations of the best quality of pressed mica. The segments are of the highest grade drawn copper of uniform hardness, and are slotted at the back for the armature leads. The mica between the segments is of a somewhat softer quality than that used in the clamping insulations, to insure an even wear with the copper segments. The completed commutator is tested by 5,000 volts between segments and shell and 500 volts between adjacent segments. Particular attention has been given to the matter of commutation, and under normal conditions the commutator will run with practically no sparking.

The brush-holders of cast brass are constructed to receive two carbon brushes per holder. The brushes are 1

$3\text{--}8 \times 2\ 1\text{--}4 \times 1\text{--}2''$. They slide in finished ways and are held in place against the commutator by independent pressure fingers, which give a uniform pressure to the brushes throughout their entire working range. The brush-holders are clamped to a hard wood yoke, carefully treated with a moisture-proof insulating compound. The brush-holder yoke is bolted to the top magnet frame and is so arranged that it may be removed through the opening in the frame over the commutator. All the leads from the motor to the car body are brought out through the rubber bushed holes in the magnet frame at the front of the motor, thus facilitating wiring of the car.

Suspension.

G. E. 58 motors are adapted to nose, yoke or side-bar suspension. The yoke suspension is especially recommended, as the weight of the motor is carried on springs placed upon the side of the truck frame. Lugs are cast on the upper magnet frame, to which the suspension bar is bolted; the lower half may, therefore, be swung down into the pit without disturbing the upper half, which remains suspended from the axle and yoke. When the motor is mounted on 33-inch wheels the clearance between the bottom of the motor frame and the top of the rails is $4\ 1\text{--}4''$; the clearance between the bottom of the gear case and the top of the track is $4\ 1\text{--}4''$. The motor, without gear or gear case, weighs 1,865 lbs.; and complete, with both gear and gear case, weighs 2,150 lbs.

OHIO ELECTRIC LIGHT ASSOCIATION.

The fourth annual meeting of the Ohio Electric Light Association was held at the West House, Sandusky, August 18th and 19th. The convention assembled at 10:30 o'clock on the morning of August 18th, at the West House, Columbus avenue and Water street.

Mr. E. C. Schmidt, vice-president of the association and superintendent of the Sandusky Lighting Company, had arranged a programme of amusements for the ladies during the sessions of the convention, including yachting and a trolley ride to the Ohio Sailors and Soldiers' Home and special trips to Cedar Point, on Thursday or Friday evening, where there were special attractions. On Saturday, August 20th, by arrangement of the Sandusky Lighting Company with the steamer Arrow, the members of the association and their friends will be taken for a trip to the islands. The steamer will leave Sandusky at 9:40, arriving at Put-in-Bay at 11:30, where members can get dinner at the Hotel Victory. On the return trip the members can leave Put-in-Bay either at 3 p. m or 6:30 p. m., arriving at 4:45 and 8:15 respectively. The return trip in the evening will be by the south channel, passing the Hotel Victory, Catawba Island, Lakeside and Marblehead.

Following is the list of papers read and discussed during the convention:

"Positive and Negative Economies in Small Central Stations," by E. P. Roberts, M. E., of Cleveland.

"Some Suggestions Relative to Determining the Cost of Electrical Supply," by M. E. Turner, of Cleveland.

"The Meter's Relation to the Dividend," by Caryl D. Haskins, of Boston.

"Comparative Commercial Qualities of Old and Modern Transformers as Applied to an Exchange," by J. H. Perkins, of St. Louis.

"Long-Distance Transmission of Power," by E. J. Berg, of Schenectady.

The following topics will also be discussed:

"What are the advantages and disadvantages of enclosed arc lamps for outside lighting?"

"Can the candle power of an arc lamp be accurately determined by the use of a portable photometer?"

"In what way can competition of the gasolene incandescent burner be most successfully met?"

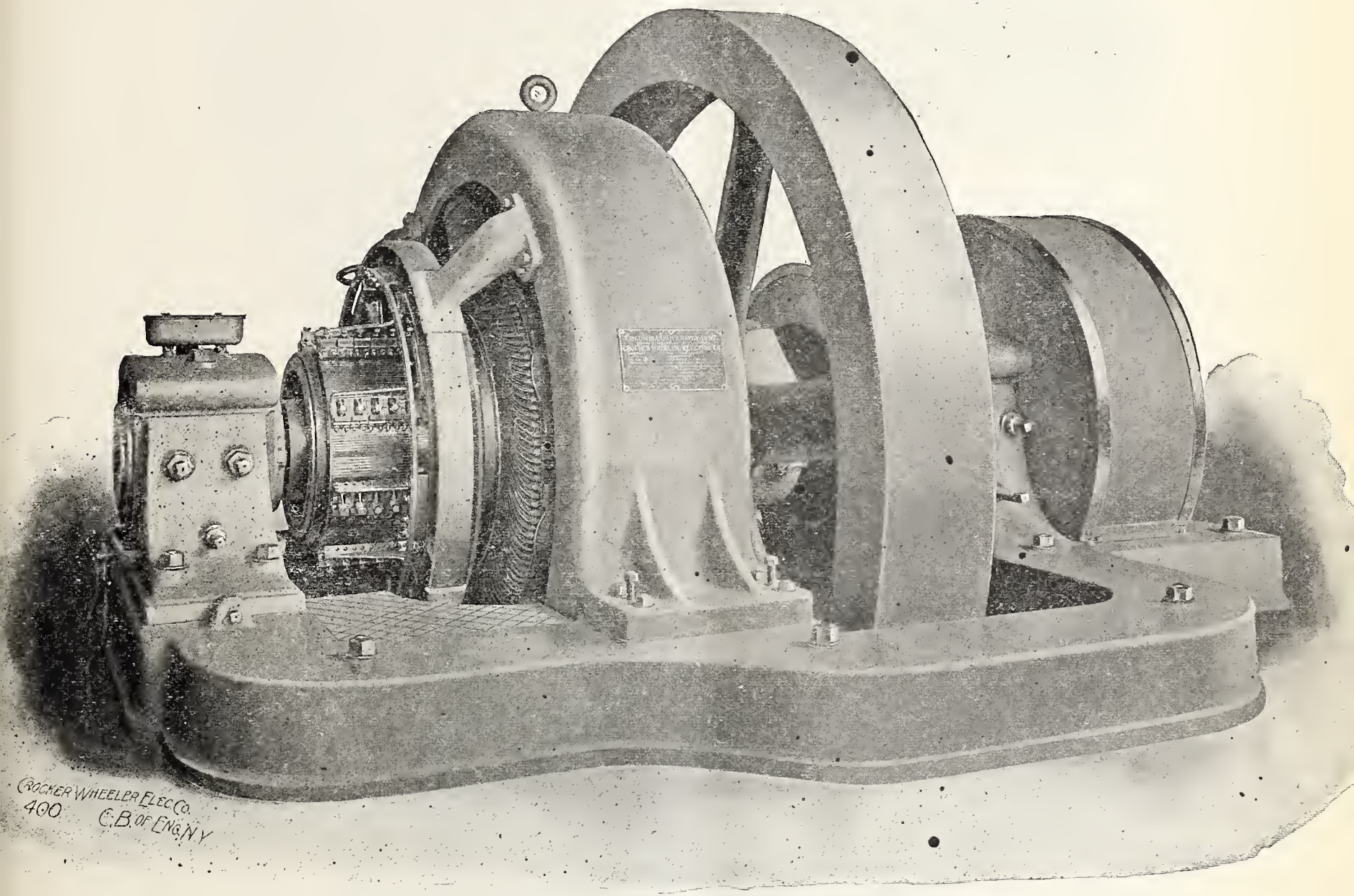
"Is it advisable for a plant to change from 15,000 volts alternating single-phase to 7,200 two-phase if no question of motor business is concerned?"

"What are the types and makes of engines in use in the smaller plants of the association; the time of their installation and their condition at the present time?"

The officers of the association are: President, H. K. Wood, Piqua; Vice-President, Emil C. Schmidt, Sandusky; Secretary and Treasurer, Samuel Scovil, Cleveland; Executive Committee, John I. Beggs, Cincinnati; B. P. Holmes, Youngstown; B. P. Foster, Norwalk; George Matt, Lancaster; E. H. McKnight, Middletown; Advisory Committee, J. Gwynn, Steubenville; A. W. Field, Columbus; D. S. Gaskill, Greenville; Finance Committee, John H. Miller, Springfield; J. I. Cooke, Ironton; Edward F. Gwynn, Delaware.

THE WARD ELECTRIC SUPPLY & CONSTRUCTION COMPANY,

Contractors and dealers in "Ward" and "Knight" lamps, imported and domestic carbons and supplies, Eugene H. Levy, Jr., president and treasurer; Chas. O'Keeffe, vice-president, and Deronda Levy, secretary and general manager, have moved to their new and handsome quarters, 194 Broadway. They are Greater New York agents for the Washington Carbon Co. They carry a big stock of plain and ornamental open and enclosed arc lamps, and give immediate attention to correspondence and telephone orders. They have every facility for carrying out contracts for complete electric light and power plants, wiring, etc. Portable and ceiling fans for all circuits. Power motors, all sizes in stock and installed on short notice. They keep in stock search lights of any



Direct-Connected Generator on Corliss Engine at Columbia University.

IMPORTANT TELEPHONE NOTICE.

The Montclair and Bloomfield Telephone Co., Independent Telephone Co., office, 462 Bloomfield avenue, Montclair, N. J., James Henderson, president; I. Seymour Crane, vice-president; Alfred S. Badgley, counsel; Geo. B. Harrison, secretary; Morgan W. Ayres, treasurer, and C. H. Carter, manager.

This company are now operating 150 telephones in Montclair under most successful auspices. The capitalists of this company have secured a charter for Bloomfield and Glen Ridge, N. J., and also New Rochelle, N. Y.

They are in the market for 500 sets of instruments, line material, switchboards, underground cables, etc. Mr. C. H. Carter, manager of the Montclair Co., is one of the most successful telephone men in this country.

Burk's Falls, Ont.—The Magnetawan Tanning and Electric Co. purpose extending their building and plant.

candle power. Office, 194 Broadway, New York; store-room, 14 Cortlandt street. Telephone, 4178 Cortlandt.

ISOLATED ELECTRIC LIGHT PLANTS.

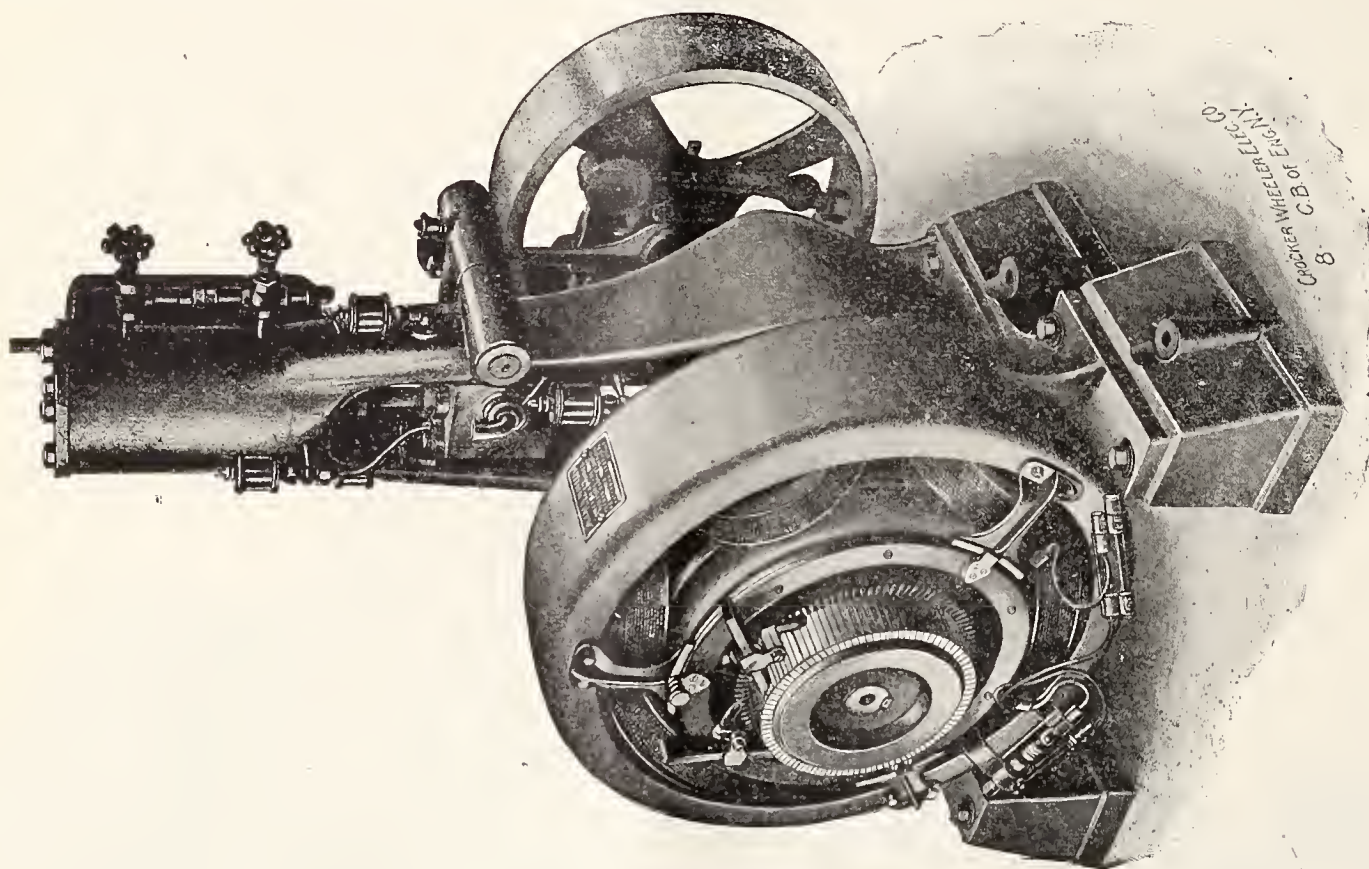
Part of the domestic equipment of some homes, particularly in the country and near the suburban portion of the city, is a gas plant. The modern residence is dependent to a large extent upon outside assistance for the continuation of the comforts within. The country resident, however, with any pretensions toward a life of luxury, cannot rely one iota upon gas pipes, water pipes, steam pipes, etc.

A home in the country is self-contained and all conveniences are found on the premises. The successful farmer leads the most comfortable life of any of this vast country's inhabitants, more perhaps on account of his independence than because of his isolation. Many farmers of the superior class, alive to the innovations of

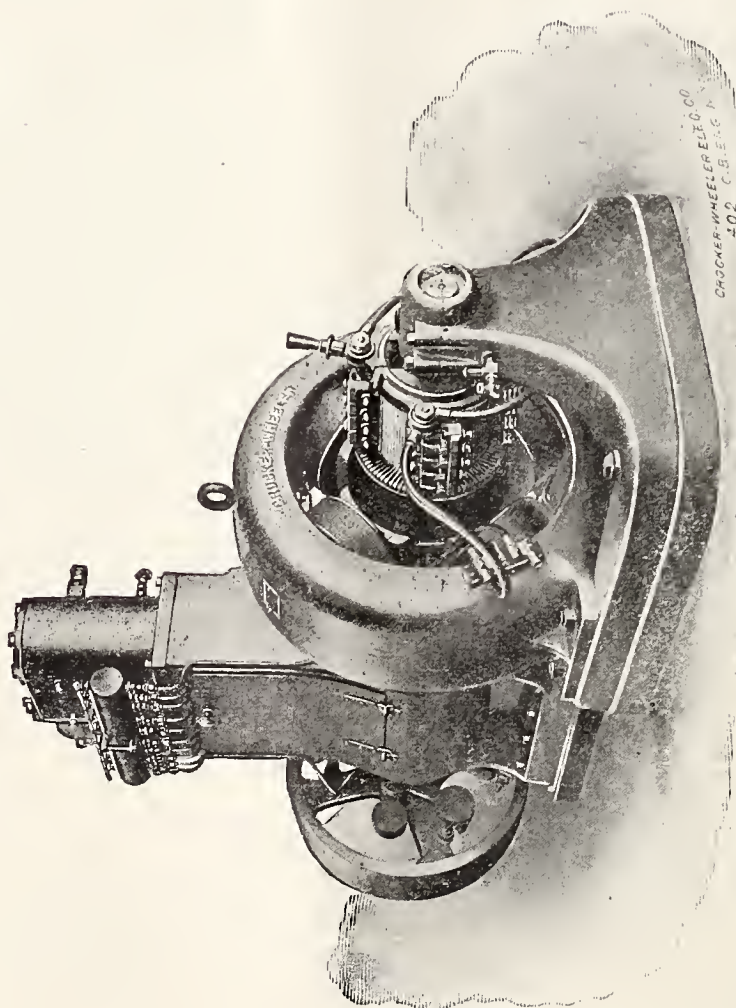
this century, have interested themselves in each one as they appeared.

Not the least interesting to proprietors of apartment houses, private homes in the suburbs or the country, is the electric light plant, some illustrations of which are given in this article. An engine connected to a

The use of oil is dangerous though cheap, and the care and attention a gas plant requires is exhausting work. In establishments where hired help is a regular thing, the additional cost of a young engineer is trifling in comparison with the money saved by the use of electric light in this manner.



Plant Installed in a U. S. Torpedo Boat



Installed in Gould's Yacht, Niagara—24 K. W. Dynamo Coupled to 6x5 Sturtevant Engine, Crocker-Wheeler Electric Company.

dynamo, as shown, has in many respects proved to be a form of happy investment, cherished by many enterprising tax-payers. An electric light plant of moderate size, ranging say from fifty to a hundred lights, will prove to be so satisfactory, if properly attended to, that the possessor of it will never cease congratulating himself upon his acquisition. The cost of gas even at \$1.00 per thousand is expensive compared with the small well-tended electric light plant.

To show on a large scale what an isolated plant means reference is made to Columbia University when at its old site. A thesis on the relative cost of lighting by gas and electricity in that establishment shows that ten thousand dollars a year were saved by the use of electricity instead of gas, the exhaust steam from the boilers heating the rooms. This is true, of course, of any small electric light plant as well, in the country and in the city. It is not likely, however, that the practice of running small elec-

tric light plants in city homes would pay because of certain municipal restrictions, and possibly the cost of an able engineer. But in thousands of cases a plant could be installed and run for little more than the cost of coal. Many farmers and southern planters have water-power on their land. They, of course, could dispense with the necessity for a steam engine and do their electric lighting at a nominal figure, but even then the cost of a dam, turbine, etc., would be so much greater than that of steam engine, boiler and coal per annum, that the plan might not be satisfactory.

A great field exists for the introduction of small steam electric light plants in the country where a few additional comforts of this description would never cease to be appreciated. The moderate cost and limited expense of operation are certainly strong inducements in their favor.

AMERICAN STREET-RAILWAY ASSOCIATION CONVENTION IN BOSTON.

One of the largest and best attended meetings of the American-Street Railway Association will be held in Boston, September 6th to 9th. Hotel accommodations for visitors and space for exhibitors will be provided for, although the Hotel Brunswick, having already booked a large number of reservations for rooms at the convention, has its accommodations almost exhausted. Other hotels in near reach of this last-named are hotels Vendome, Commonwealth Avenue; Copley Square and the Thorndyke Providence Station. Among other hotels may be found the Asams House, Young's Hotel and the Parker House, near the centres of commercial activity and from ten to twenty minutes' ride from the convention hall. The La Touraine, one of the most magnificently equipped hotels in this country, located at the corner of Boylston and Tremont streets.

At the Brunswick five manufacturers only have been able to secure headquarters on the ground floor, namely, the General Electric Company, which has the main reception room; the J. G. Brill Company, directly opposite; the Peckham Motor Truck & Wheel Company, the Pennsylvania Steel Company and the Bethlehem Iron Works. On the second floor, headquarters have been secured by the Westinghouse Electric Company and the Christensen Engineering Company.

The convention space for exhibition purposes is practically unlimited in amount, and manufacturers may feel confident of securing all of which they may apply for. Applications should be sent to Charles S. Clark, chairman committee on exhibits, Mason Building, Boston, Mass.

The street-railway managers around Boston are taking most lively interest in the coming Convention. A strong general committee has been appointed to take care of the Convention, with General William A. Bancroft, vice-president of the Boston Elevated Railway Company, as its chairman, and with a large number of sub-committees, whose chairmen form members of the general committee. The plans for entertainment of the visitors have already been partially formulated, and include a harbor excursion of the most interesting character.

One of the points of interest to be noted in Boston will be the new subway, which we expect to see entirely completed by the time the American Street-Railway Association meets. Besides this there are many specimens of engineering in and around the vicinity of Boston which will keep delegates busy examining. On the whole this convention promises to be one that will mark an epoch in the history of the association, and we hope that all our friends finding it possible will attend the above gathering.

Brantford, Ont.—A company has been formed here for the construction of an electric railway between Waterford and Port Dover.

THE DIESEL CALORIC MOTOR AT THE MUNICH EXPOSITION.

In a report describing briefly the new caloric motor invented by M. Rudolf Diesel,* it was stated that at the machinery exposition to be held at Munich this summer a collective exhibit would be made by the several firms and companies in Germany which have begun the manufacture of Diesel motors of different types for practical use.

The exposition was opened with great éclat early in the present month and will continue until October. The display of Diesel motors occupies a special building, and, in view of the originality and vast economic importance of the new engine, is recognized as the most interesting feature of the exhibition. The interest manifested in this invention by American engineers and machinists has been so general and insistent that a brief account of what can be seen at Munich during the coming three months may be of timely import, although it is generally known that all patented rights for the construction and use of the Diesel motor in the United States have been acquired by an American company whose main office is at No. 11 Broadway, New York.

The collective exhibit at Munich is made by the Augsburg Machine Company, where the invention of Mr. Diesel was first built and tested in practical form. Messrs. Fred Krupp, in Essen, the Machinery Construction Company, of Nuremberg, and the well-known Otto Gas Motor Manufacturing Company, of Deutze-Cologne—four of the most important and powerful manufacturing firms in Germany, whose names form a sufficient guaranty of the industrial value of the new engine. The Diesel motors on exhibition are five in number, and are described in the official catalogue as follows:

(1) By the Augsburg Machinery Company: Single cylinder, 30-horse power motor, for petroleum fuel; drives a rotary pump that lifts 1,600 litres (398 gallons) of water per minute to a height of 60 metres (196.7 feet.)

(2) By Fred Krupp, of Essen: Single-cylinder, 33-horse power engine, which drives a high-pressure, centrifugal pump that draws up from the River Iser a stream of water that is projected through a two-inch nozzle at 45° elevation to a distance of 230 feet into the river.

(3) By the Machinery Construction Company, of Nuremberg: A single-cylinder, 20-horse power motor, which, at a speed of 180 revolutions per minute, is used for purposes of test and demonstration.

(4) By the same company as above: One double-cylindered, 40-horse power motor, coupled directly to a Shücker dynamo, and at 180 revolutions per minute generates current for lighting the pavilion and driving a fast rotary printing press and several machine tools which are installed in the same building.

(5) By the Otto Gas Motor Manufacturing Company, of Deutze-Cologne: One single-cylinder of 20-horse power, which propels a Linde condensing machine for the production of liquefied air.

Besides the four firms above named and represented at the Munich Exposition, three others—viz., the H. Paucksch Co., at Landsberg-on-the-Warthe; L. A. Rudinger, of Augsburg, and the Diesel Motor Fabrik, a special establishment organized at Augsburg for the purpose—are all now interested and engaged in the manufacture of Diesel motors for practical use. The invention, which was first publicly described at the meeting of the German Engineers' Association hardly a year ago, has thus already entered upon its career of economic usefulness.

The Munich Exposition of 1888 revealed as its dominant note the previously unknown preeminence of Germany in the development and utilization of the gas engine as a source of motive power, and it will be the principal function of the exhibition of 1898 to show in how far the Diesel motor surpasses—in respect to economy of space

* See Consular Reports, No. 208 [January, 1898, p. 21.]

and fuel, cleanliness and practical efficiency for a wide range of purposes—all other motors, whether propelled by steam or which dispense with the evaporation of water and burn the fuel inside the cylinder.

Frank Mason,
Consul-General.

Frankfort, June 25, 1898.

CANADIAN LETTER.

Electric Railways.

Lanark, Ont.—It is claimed that the necessary capital has been secured for the construction of the proposed

THE TRANSMISSION OF POWER.

LESSON LEAVES

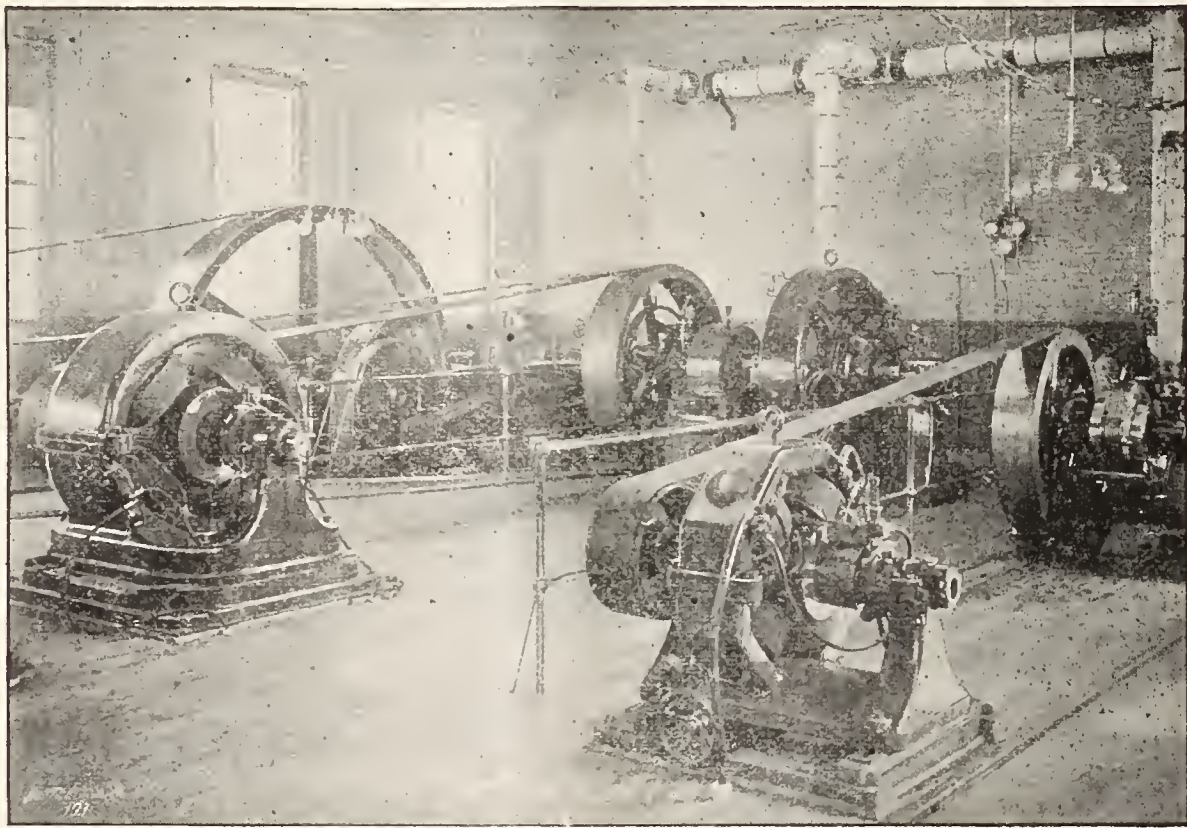
FOR

THE AMERICAN SCHOOL OF ELECTRICITY.

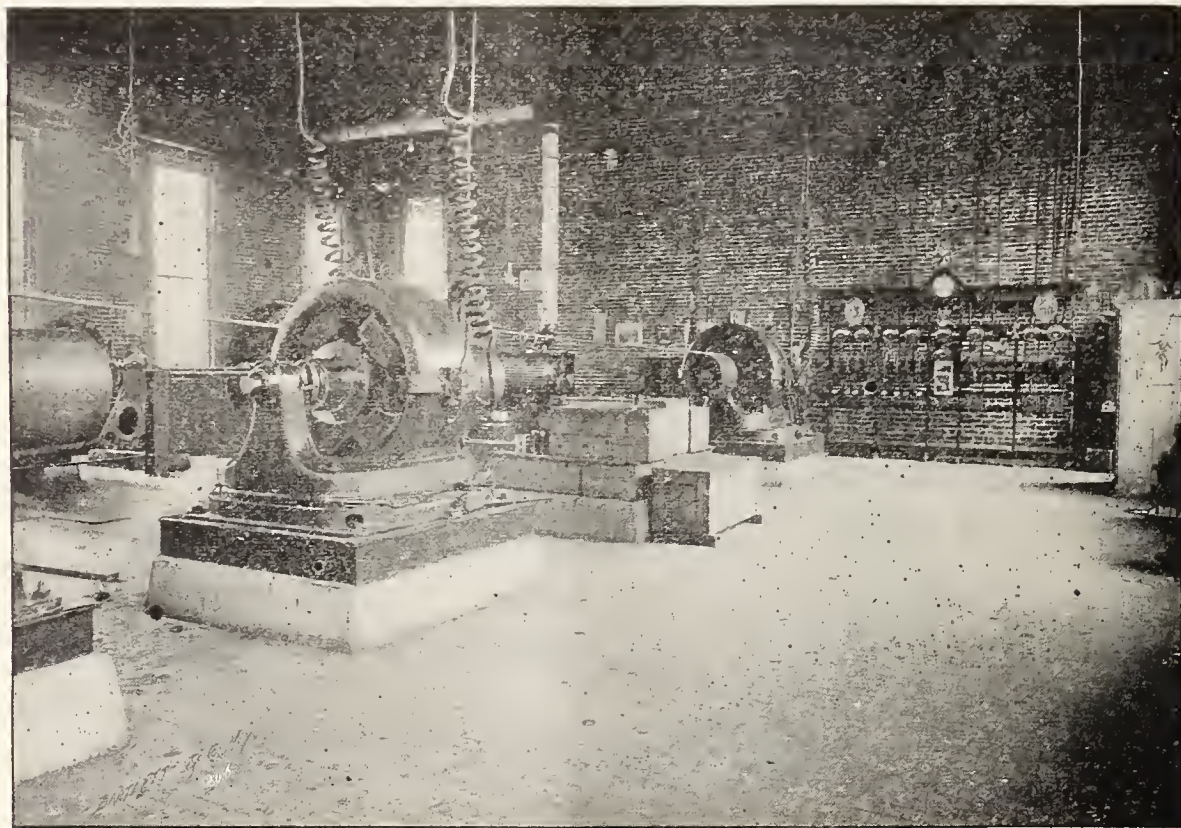
BY NEWTON HARRISON, E. E.

Power is transmitted by means of

Steam,
Wire Rope,
Electricity,
Compressed Air,



Interior of Power House, Crocker-Wheeler Works, Ampere, N. J.



Power Plant, Granite City Steel Company, Granite City, Ill.—Three 100-Kilowatt 230-Volt Dynamos, Furnishing Current for Arc Lamps, 220-Volt 16-Candle-Power Lamps and Motors from the Same Machines.

electric railway between Lanark and Perth.

Nelson, B. C.—S. C. Drummond, representing The British Electric Traction Co. of London, Eng., has applied to the City Council for a charter for an electric railroad. The Council has signified its willingness to grant the application on suitable terms.

Hydraulic Pressure.

The evident use of each is only to be determined by the existing conditions. At present but two have received such consideration as is required to lift them into prominence.

They are wire rope and electricity. In our busy towns

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

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NEW YORK, AUGUST 20, 1898.

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INJURY TO ELECTRICAL INVENTORS.

The recurrence of great frauds related in some way to the electrical science has led many investors to shun electricians as they would his satanic majesty. This is mainly on account of schemes developed by adventurers on frequent occasions and supported by the gullible element. The mystery surrounding electrical inventions is regarded by the long-suffering public even at this late hour as a sign of their value, a proof of their evident originality. The Keeley motor is an example of this in the field of applied mechanics, and in all respects the recent efforts of the Rev. Mr. Jernegan is a fair illustration of what people believe in relation to electrical discoveries.

Preposterous as the idea is of actually extracting gold from sea-water we are certain that the backing of scientific fact upon which this process was supposed to rest was not doubted for an instant by the laymen. Science wields the wand of control over Nature to an extraordinary degree and brings to light wonders that the uninitiated only regard as facts after repeated proofs of their existence; yet such a scheme as the extraction of gold from the sea was considered possible without other tokens than those presented by the ringleaders of the Electrolytic Marine Salts Company.

The serious effects of this upon investors or those claiming a less dignified title, aside from the fact that they are solely to blame, is to make them regard everything related or associated with electricity as a fraud. Not only is this detrimental to the profession by crushing all efforts on the part of inventors of electrical devices to place their patents, but it retards the process of practical commercial development in several ways.

Those already interested in electrical enterprises may fall away in fear, and others preparing to invest in what

was regarded as legitimate will feel by this disclosure that they have been saved from a sad fate and retire with a shrewd wink at their own perspicuity.

The throttling of legitimate enterprises is one of the worst accidents that can happen to a growing science. Although requiring no further recommendation than the successes already achieved, the application of electricity to a new purpose is now apt to awaken suspicion in the minds of those always anxious to be on the safe side and possessing a painful recollection of events connected in the past with shady propositions. This class of men are of course as great an obstruction to progress as the milder form of frauds. What would certainly prove to be an excellent antidote more effective than anything that could be otherwise suggested would be the possession of information by business men and the general public of the limitations of applied electricity.

The time has arrived in which no man can consider himself well informed who does not possess some knowledge of the fundamental principles of applied sciences. Knowledge is undoubtedly power in virtue of such an education and may be the saviour of many a bank account from complete destruction.

The idea that this is the age of specialists is true in the sense that livelihoods are best earned by those imbued with resolution enough to stick to one business or profession. It is not necessary to conclude from this that a familiarity with simple facts in connection with any other subject is a departure from the beaten paths and therefore inimical to success. Not in the least; such knowledge is helpful. It protects the specialist from imposition. It is a shield from attacks that threaten his present prosperity and future happiness.

Business men are as much exposed to the machinations of schemers as our New England lambs. Case upon case could be cited showing the credulity of experienced New York business men, but none in which professional men have been fooled in their own science. An elementary training in a few of the important principles and applications of electricity by the general public would undoubtedly have saved thousands of dollars from the clutches of the Rev. Mr. Jernegan.

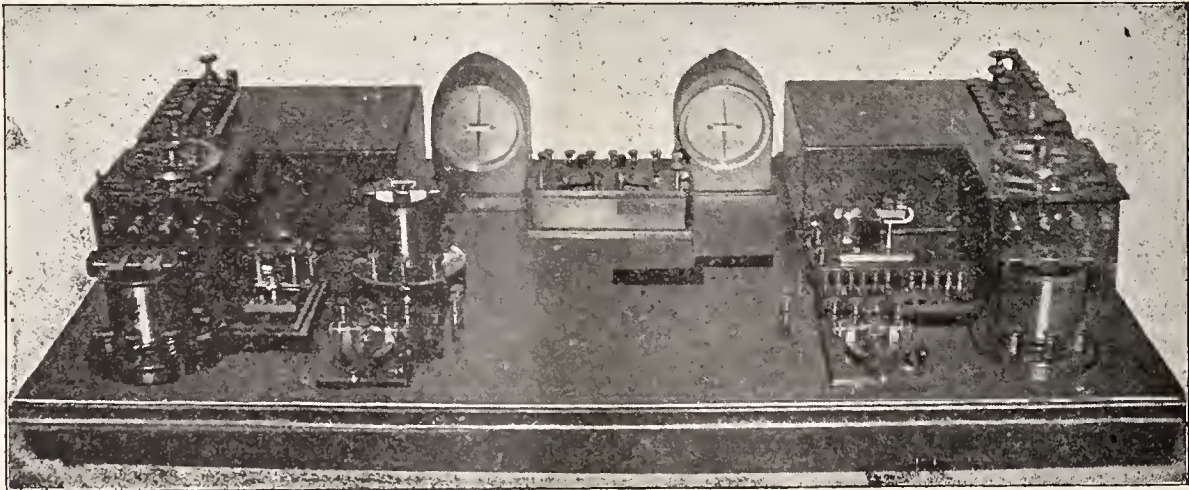
The daily newspapers and periodicals have for many years taken an extraordinary interest in all electrical discoveries and inventions. The knowledge the people possess of the electrical science is obtained by them mainly from these sources. Of course the facts are superficially stated and possess little value as a source of instruction, but they at least make the people acquainted with the latest scientific news. Would it not be a good idea for these same journals to occasionally prod the public mind to a sense of its ignorance by presenting in a popular manner a few of the fundamental principles of electricity as well as other sciences.

In the course of a few years the training the public received would make them as familiar with science as they are with bimetallism; as ready to discover a fraud before it is perpetrated as after the harm has been done. We find that the Sunday editions of the daily papers have begun this good work, but not seriously. We therefore hope to find more attention paid to this great educational work by them in the near future. Frauds sometimes prey upon the public's purses in so insidious a manner that the police cannot interfere. Let the great newspapers warn and protect them from such reptilian criminals. That is undeniably one of their functions.

Grand Falls, N. B.—A company has been formed composed of Sir William Van Horne, Senator Proctor, of Vermont; Mr. Alger, Secretary U. S. Navy, and others, to develop the water power at this place and transmit electric power north to River du Loup, and south to Woodstock. The developing works are expected to cost \$20,000.

and less settled suburban districts the trolley has been a great success, while the cable is limited in its application on account of the great expense of running and installation. The line must be drawn, however, between those systems which distribute and those which transmit power. The distribution of power is carried on at the extremity

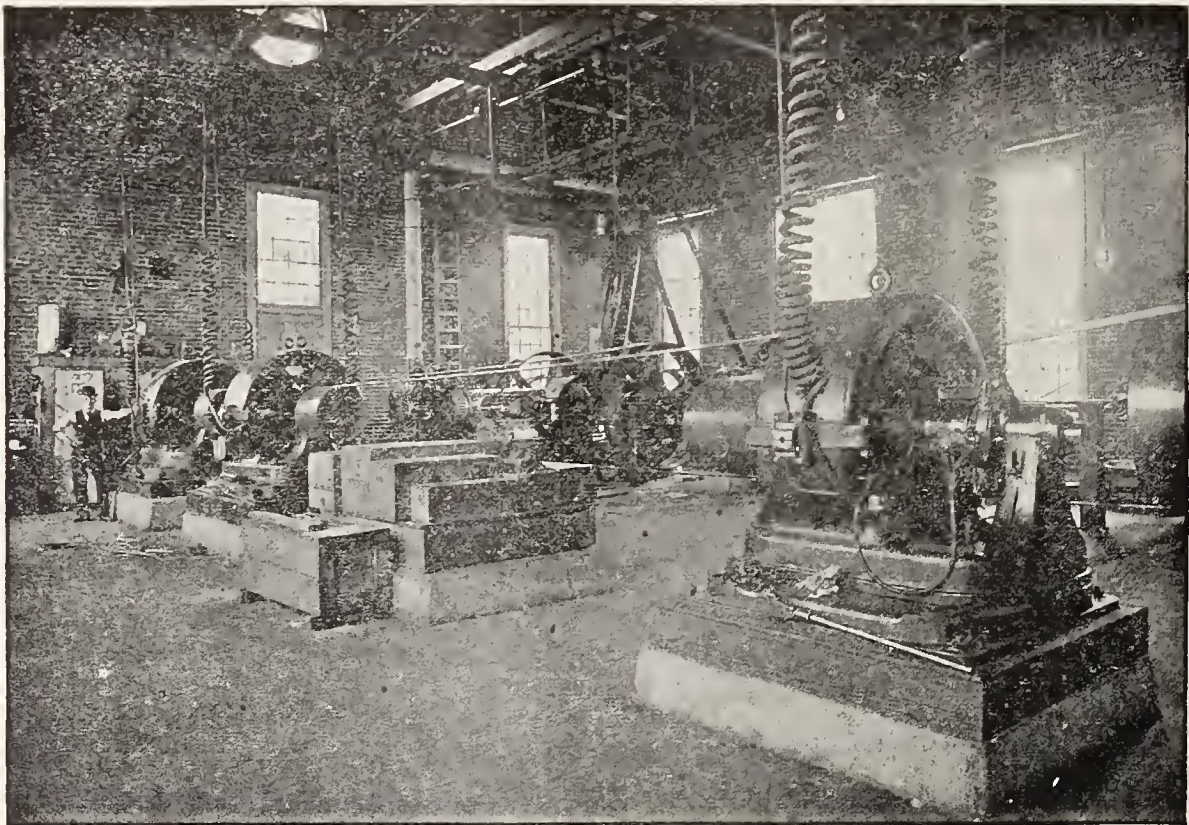
from point to point with the least possible waste and expense. This happy combination is only secured by investigating the conditions that exist. The efficiency of a system of transmission might be affected by the distance, locality, etc. For instance, the efficiencies of a wire rope transmission plant of the following distances are given by



Line Testing Outfit.

of or along a power line. The transmission, between two distinct centres. A line stretching from Niagara to New York would be a power transmission line; from the heart of New York to its innumerable streets and adjacent districts, merely distribution would occur. The case that would come more closely in touch with the title of this article would be that of two widely separated centres between which a line is to stretch carrying power from one to another.

Kapp:
Distance in feet, 300, 1,500, 3,000 15,000 30,000 60,000
Efficiency, .96 .93 .90 .60 .37 .13
The same would naturally follow with any other source of power—that the greater the distance over which it extends, the greater the loss in power. As given by Herr Beringer and referred to by Gisbert Kapp, the following interesting table shows the relative efficiencies of each



Another View of Power Plant, Granite City Steel Company, Granite City, Ill.

To determine the loss in power, weight of copper, volts required and general expense, is a problem having some weight in the transmission of power. It is in reality all there is to the transmission of power, because it covers the most important points, touching all things from the standpoint of economy. If an electric current could be sent at random over any line without the least attention being given to insulation, pressure or current, then the subject of transmission of power would never have been dignified by such a title. It should be the object of every engineer to send power

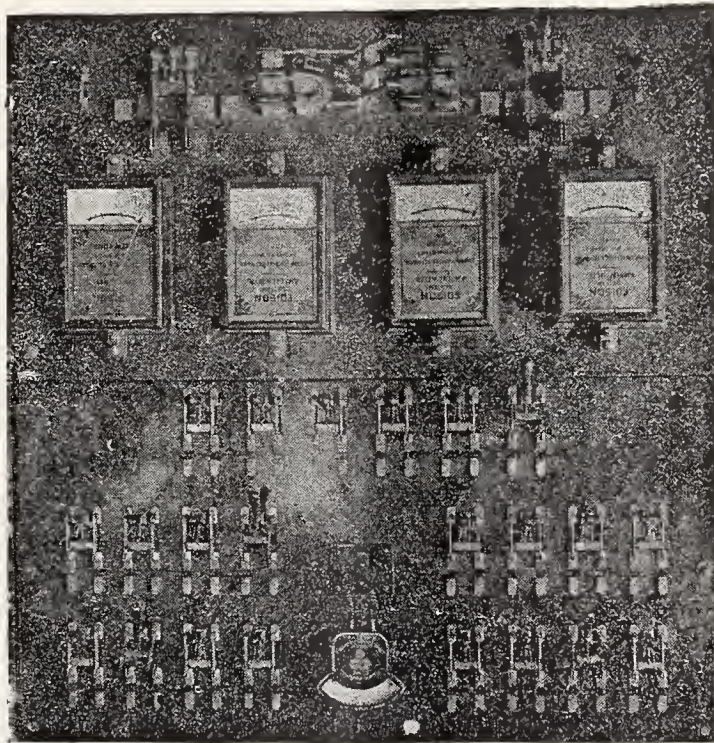
system:
COMMERCIAL EFFICIENCY.
Distance. Electric. Hydraulic pressure Compressed air. Wire rope.
300 ft. 69 per cent. 50 per cent. 55 per cent. 96 per cent.
1,500 " 68 " 50 " 55 " 93 "
3,000 " 66 " 50 " 55 " 90 "
15,000 " 60 " 40 " 50 " 60 "
30,000 " 51 " 35 " 50 " 36 "
60,000 " 32 " 20 " 40 " 13 "
Before 1891 these figures were compiled, and the line of electrical efficiencies is very much higher than the above to-day. It is not very difficult to send 1,000 horse-

power a distance of 100 miles, 528,000 feet, at an efficiency of over 60 per cent. As an example of the limitations imposed by distance and material, take a copper line having 10 per cent. with drop machines at each end of 90 per cent. efficiency—that is, motor and dynamo—what is the efficiency of the system?

The dynamo at 90 per cent. loses 10 per cent. in the line; that is 81 per cent. left for the motor. If the motor has 90 per cent. efficiency, it returns as power 90

commutators, and being easily susceptible to transformation, the alternator is at present superior to all as a generating device.

In 1881 Deprez, of France, proposed that the current be generated at a low pressure, raised to a high potential, sent over the line and reduced to a low pressure again for commercial purposes. To accomplish this, continuous as well as alternating-current transformers may be used. If the plant is a high-pressure continuous-current system,



General Arrangement of Power-Distributing Switchboard.

per cent. of 81 per cent., which approximates 72 per cent. in total. What conclusions may be drawn from this other than that if motor, dynamo and line each have only 10 per cent. loss, the system is of 72 per cent. efficiency over any distance as long as these conditions with a continuous current are observed.

The latest feat of engineering has been the design and construction of a huge power plant at Niagara Falls. In Germany, between Frankfort and Lauffen, a line 100 miles long was extended. The power was generated at Lauffen. A turbine that gathered energy from the Neckar River was used and a three-phase alternator.

The current generated was 1,400 amperes at 50 volts pressure. It was transformed before entering the line to 30,000 volts, and when received at the other end (Frankfort) again reduced to 60 volts. According to an official test, when 80,500 volts were sent out 58,000 were received; the efficiency being 72 per cent. This account of what may be considered the first experiment of any consequence in this direction gives satisfactory results. The distance over which the power was transmitted was 108 miles.

It is not difficult to attempt to transmit heavy power over long lines, as a precedent has been established which today may be looked upon as successful. The difficulty of using continuous current for long-distance transmission is that of transformation.

Power can be economically sent from point to point as long as the pressure is high. The efficiency of a plant depends upon the voltage of the line to a greater extent than anything else. Continuous-current dynamos use commutators which give rise to sparking troubles when high pressures are used. They cannot be safely connected in series, although the idea seems plausible, because the insulation is apt to give.

The economy of transmitting power is somewhat affected by the cost of the repairs. Weak machinery is as detrimental to a plant as poor insulation. There are no continuous-current generators in existence that could safely be used for high tension work. Such pressures, for example, as 10,000 or 20,000 volts. Not requiring

an increase or reduction in pressure is obtained by using a motor and a dynamo in one. The armature is wound twice—once for a motor to receive the power, and again as a dynamo with sufficient turns and commutator to produce the pressure required.

The machine is called a motor dynamo or continuous-current transformer. The armature having two windings and two commutators is expensive and unsatisfactory for this purpose, except in special cases.

On the other hand a transformer, as previously described, is a simple magnetic circuit interlinked with coils. The absence of moving parts makes its use extremely practical. The difficulty of insulating it has been well overcome.

In transmitting power by alternating current the choice that exists lies between—

Single-phase,
Two-phase,
Three-phase systems.

In certain respects the two-phase has many advantages, but the matter is still in abeyance.

It may be said, however, that single-phase transmission plants are entirely out of the question. This now leads us to the examination of the reasons for choosing between the three.

Before the multiphase motor was invented, the single-phase current could not run a large alternating-current motor unless it was first started by some other source of power and set into synchronism.

The introduction of two and three-phase currents, however, provided a means for overcoming this defect. Motors became self-starting when built on this principle and were introduced as a successful commercial feature of an alternating-current plant.

This, then, in total, may be considered the reason why alternating-current apparatus has become popular. The erection of a plant merely for the purpose of furnishing light is ridiculous, if conducted on a large scale. The transmission of power in one sense defines the object in view, and how is it possible to develop an enterprise so

handicapped at the outset? Competition with continuous-current plants, even though such installations cost twice as much, would eventually drive from the field those advocating another principle, yet unable to meet all of its demands.

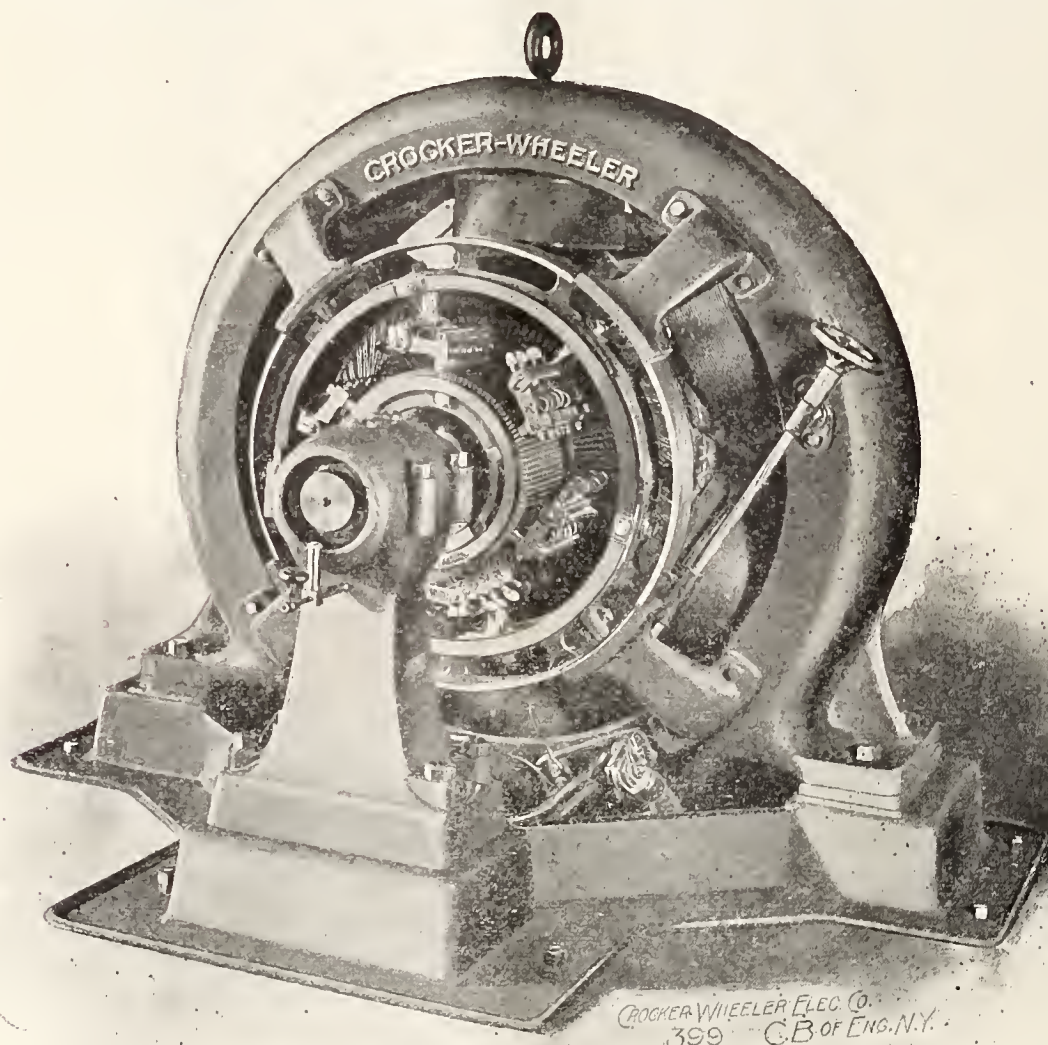
The transmission of power is successfully carried on with a high pressure, an easy transformation, efficient motors and good line insulation. Attention to these factors means attention to the very elements of success.

QUESTIONS FOR REVIEW.

- (1) How is power transmitted?
- (2) What is a power transmission line?
- (3) What system is most economical over short distances?
- (4) Why is a high potential necessary for the economi-

The exclusive use of wrought and cast iron for dynamo construction is now an ancient practice. Steel frames are used in the majority of cases and the high permeability and lightness of this material makes it a permanent factor in dynamo construction. The most advanced builders of electrical machinery have led the way in the adoption of the multipolar type of frame for the generation of electricity on a large scale, also in the use of mild steel for the complete or partial construction of the same. It may be said that the body of the machine has grown lighter and the armature grown larger and heavier.

The illustrations added to this short sketch show in general the design of a Crocker-Wheeler dynamo of the multipolar type. Whereas the illustrations are not directly related to each other and do not represent the same machine throughout, they show certain points in



Type of the Most Modern Design in Generators.

cal transmission of power?

- (5) What is the purpose of a motor dynamo?
- (6) How is power transmitted by alternating current?
- (7) What is meant by
 - Single-phase,
 - Two-phase,
 - Three-phase currents?

DYNAMO DESIGN.

The design and construction of dynamos and motors has been reduced to a science. Continuous current and alternating current machines are in daily use by the thousand for all purposes, including electric lighting, power transmission and distribution. The efficiency of a dynamo depends so largely upon a thorough knowledge of a few simple principles that it is absolutely impossible to build a machine of this description unless guided entirely by the experience of others and your own intelligence. In earlier days the mere generation of a current was considered remarkable; today the features of a modern machine are sparklessness, coolness in running and high efficiency.

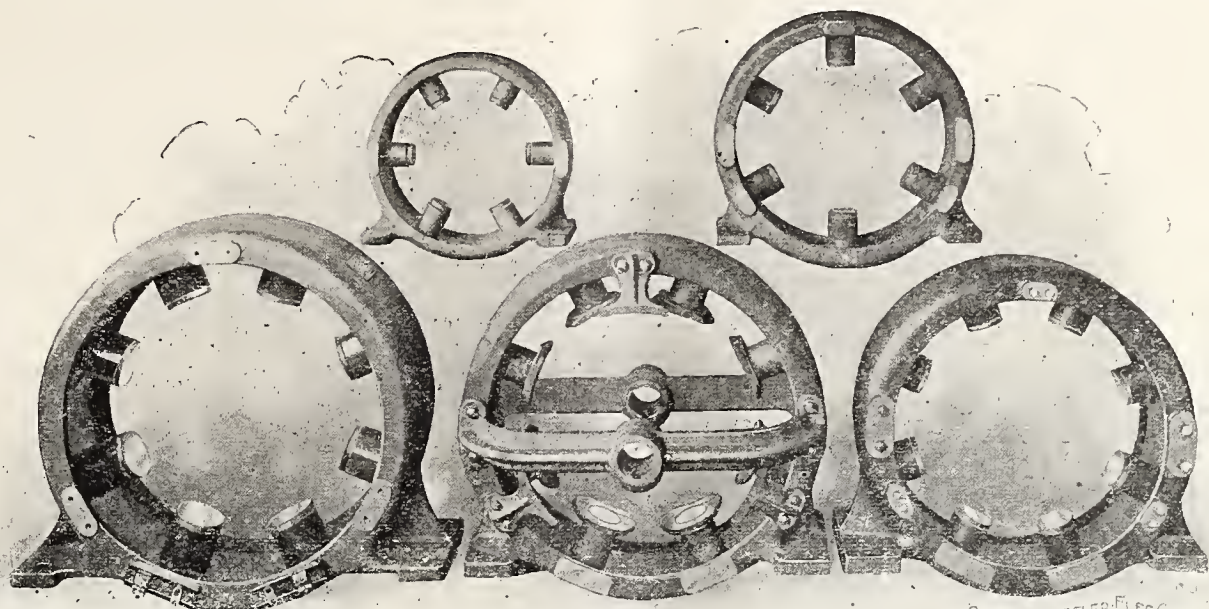
construction which are interesting. In the frame the lack of any excess of metal is noticeable. Enough magnetic material has been used to carry the lines of force and no more. In the armature, provision has been made to properly transmit the lines of force from pole face to pole face and yet allow of sufficient ventilation and enough conductors to generate current and pressure required without crowding.

Sparking at the commutator, according to the opinion of one of the founders of this company, is avoided by saturating the armature core, thereby preventing or neutralizing the effects of self-induction at the moment the commutator segments are short circuited by the brush. Sparking at the brushes may be traced to the size of air gap, ampere stream and strength of magnetic field. An adjustment between these three, if carefully made, will absolutely annihilate this disagreeable phenomenon. A design of the pole piece will, by producing the proper magnetic spray, assist in this reform of the ancient design. An allowance of sufficient radiating surface on both fields and armature will prevent the accumulation of heat. A machine that does not spark or unduly heat is one which is apt to be highly efficient.

The absorption of power in any case is noticeable to such an extent that the point or location at which a loss occurs can be easily traced.

Commutator construction has been reduced to such a system that none of the faults they were at one time heir

con, the ethopticon, the polyopticon, etc., in addition to those compound types which produce dissolving views. As far as the electrician is concerned, the stereopticon or magic lantern has met with improvements which are entirely due to his interest in their development.



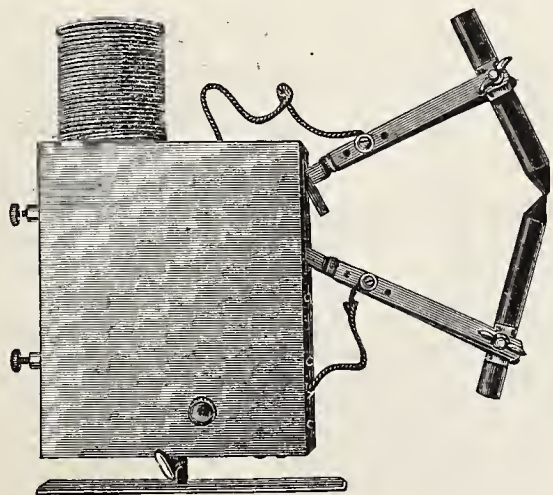
Field Frames, composed of Cast Iron Yokes and Mild Steel Cores.

to exist any longer. Loose bars, projecting segments, poor insulation or quickly wasting metal are no longer in vogue. The perfection of the commutator from a mechanical standpoint has had its influence in prolonging the life of a machine and gaining public confidence in its commercial application. With steel fields, a well laminated slotted armature and a large radiating surface the three most pressing requirements are met with, and the possibility of constructing an efficient and lasting piece of machinery is quickly assured.

In conclusion it may be stated that efficiency does not hold a candle to durability. The struggle that has gone on to gain a few per cent. this way is a useless one. Good design will bring with it the highest practical efficiency, and if associated with intelligent mechanical construction it will certainly lead to the production of a generator whose period of active service may be almost indefinite.

THE MODERN MAGIC LANTERN AND ITS ELECTRICAL IMPROVEMENT.

The magic lantern has been blessed with as many names as some of the titled grandees of Spain, but it has

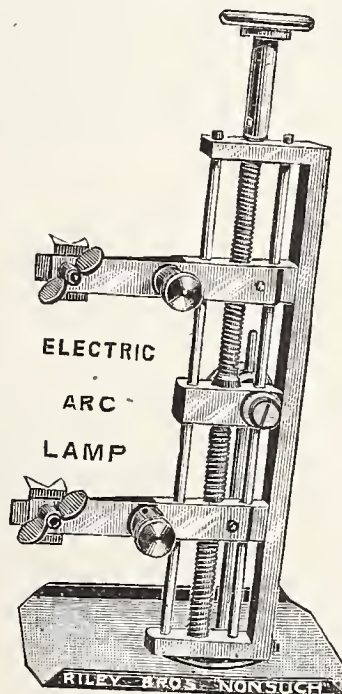


Automatic Feed Stereopticon Lamp.

remained, in spite of these sobriquets, a source of enjoyment to the great multitude, which is, to say the least, remarkable. In its varied forms it appears, with different degrees of mechanical elaboration, as the stereopti-

The introduction of the arc light for lantern use and the invention of the kinetoscope brought the attention of the world to the high state of perfection these instruments had arrived at. Riley Brothers, of 16 Beekman street, New York, with offices at 55-57 Godwin street, Bradford, England, and 22 George street, Dunedin, New Zealand, have carefully developed their business in this class of apparatus in every possible direction. As a result of their study and attention to its details, they stand in the position of authorities on the subject of stereopticons, magic lanterns, etc., being prepared to give all information relating to the same. Some illustrations of the apparatus they handle are to be found in this article. Dissolving view lanterns and those fitted with hand feed electric lamps are brought to the reader's attention. A form of portable lantern is presented which has met with great success. Likewise the kinetoscope they pay special reference to.

The lenses, mechanism, superior finish and magnificent slides sold by Riley Brothers have won world-wide re-



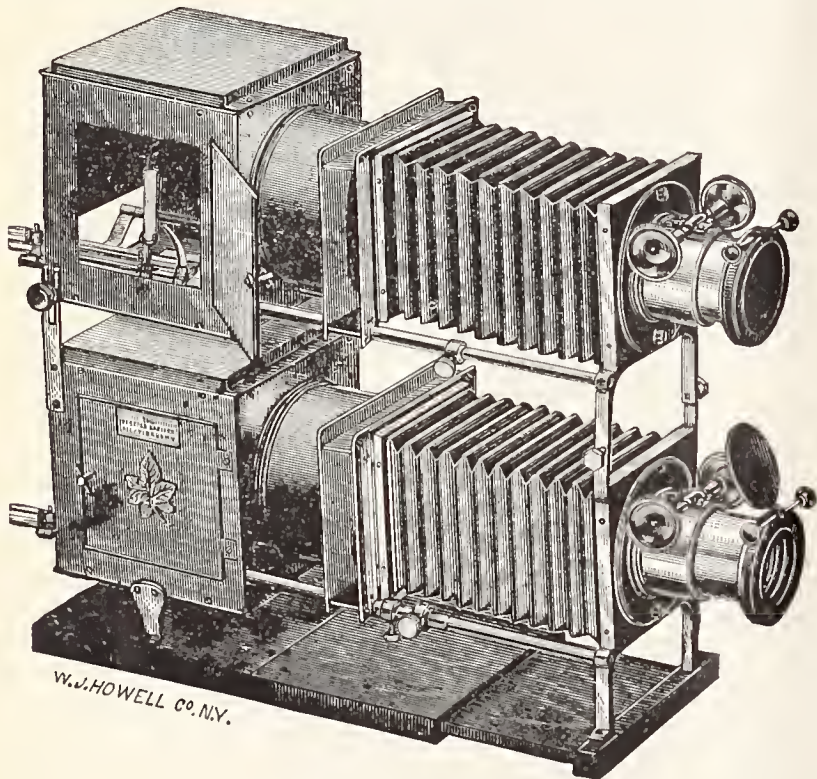
Riley Bros. Hand-Feed Electric Lamps.

known for them in every civilized centre on the globe, and we advise our readers interested in this class of apparatus or contemplating purchases to write to this concern at the address given, 16 Beekman street, New York city.

DEVELOPMENT OF CENTRAL STATIONS.

(Continued from page 96.)

It is not my wish to address you on the scientific or technical side of central station development. I have thought it necessary to go at length into the early work of the art more for the purpose of giving you some idea of the position to which Mr. Edison is entitled as the father of central station work. My limited knowledge of the technique of the business would not permit me, even if I wished, to discuss the details of his early work, or of the early work of other experimenters; but I assure you that



The Pastor's Portable Lantern.

daily familiarity with the operation of one of the largest central stations in this country gives me a higher and higher appreciation of the simplicity and thoroughness and adaptability to all purposes of electrical distribution of the great work accomplished by the "Wizard of Menlo Park."

As a result of the experiments at Menlo Park Mr. Edison, early in the winter of 1880, started to get together the necessary data for the establishment of a central station and distributing system in New York, in the district bounded by Wall street on the south, Nassau street on the west, Peck Slip on the north, and South street on the east, a territory covering about 2,000 feet square. He had each house thoroughly canvassed to show the number of lights in use, the number of hoistways and elevators, and the horse-power of the engines running machinery. You will find on the walls around us the blue prints of these original canvasses.* On one blue print you will find an enumeration of the power in use in that district, and on the other blue print a record of the lights there used. As a result of this canvass, the Edison Electric Illuminating Company of New York was formed and drawings prepared for a central station, which was erected at 255 and 257 Pearl street, the capacity of the station being 2,000 horse-power, and the district fed by a system of half-round copper mains and feeders, the mains being enclosed in lengths of iron pipe and insulated by a bituminous compound, each length of main being between twenty and twenty-one feet, so that it was possible to take off a service at each house.

Time will not permit me to go into the details of construction of this, the first central distribution station. You will see, by referring to the outline drawings of the station which I have with me, that the boilers were placed down below and were of the horizontal water-tube type, made by Babcock & Wilcox, carrying a pressure of 125 lbs., the

steam machinery and dynamos being of the direct-connected type and placed on a steel structure not dissimilar to that of some portions of the elevated railroad structure in New York.

Great care was taken in figuring out the system of mains and feeders, an immense plot of the district being represented by a series of resistances showing in miniature the probable consumption of current in the various parts of the district. It should be remembered that the path to be followed was practically unknown, that electrical distribution on a large scale was as much of a hidden secret as an unexplored continent, and the remarkable thing is that this first experimental system was a practical success, and a return on the money invested was being earned before electricians at home and abroad would recognize the success of the undertaking. It is but natural that many devices were used which were subsequently absolutely discarded. For in-

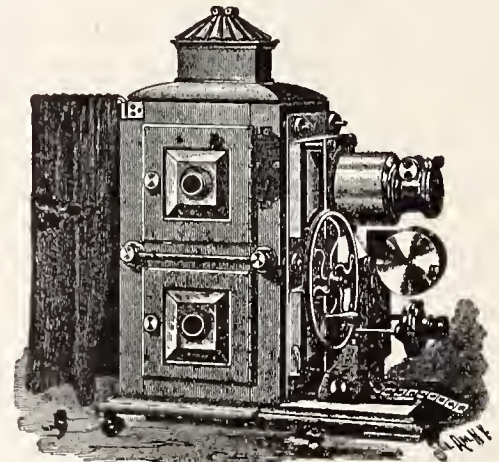


Fig. B.—Cinematographs.

stance, an elaborate system of resistances placed in series with the feeders was employed for maintaining an even pressure, entailing a considerable waste of energy. The lamp employed was not more than one-half as efficient as that used to-day, while the cost of manufacture was many times greater, and it had not one-quarter of the life of the present commercial incandescent lamp.

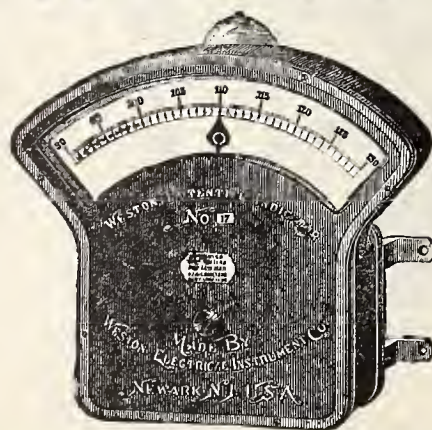
(To be continued.)

* The charts, curves, and drawings referred to in the lecture are part of the confidential records of the Chicago Edison Company and the Edison Electric Illuminating Company of New York. It is therefore impossible to publish them.

Brantford, Ont.—The city has decided to dispense with gas for lighting purposes, and will ask tenders for electric light; also for installing an electric light plant to be controlled by the city.

Quebec, Que.—It has been decided not to extend the electric railway to Montmorency this year, but everything will be in readiness to change the system from steam to electricity next year.

WESTON STANDARD ILLUMINATED DIAL STATION INSTRUMENTS.



THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

Telephone Service In Westchester

(EXCEPT YONKERS)

FROM \$30 A YEAR.

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FROM \$90 A YEAR.

An Extension Station

saves time and trouble, insures privacy, adds to the convenience and flexibility of the telephone service. The rate for an Extension Station, to Message Rate Subscribers, is now \$1.00 a month, with installation charge.

"Busy Lines"—

The private Branch Exchange is the proper cure. Many lines are "busy" from 50 to 200 times a day. This is tantamount to turning away business every working day.

A properly designed Private Branch Exchange is never busy.

Stations \$1.00 a month and cost of installation; messages, lines and other equipment at correspondingly low rates.

Public Pay-Station Rates.

TEN CENTS

For a message in Manhattan.

TEN CENTS

For a message in The Bronx.

TWENTY CENTS

For a message passing between Manhattan and The Bronx.

War Taxes.

No increase has been made to the tolls for out-of-town telephone messages on account of the War Revenue Tax.

The Telephone System of Manhattan Island is the Largest Metallic-Circuit System in the World.

Considering the quality of the service furnished, the refinement of the facilities supplied and the cost of maintaining the plant and organization, telephone charges are nowhere in the world more reasonable.

NEW YORK TELEPHONE COMPANY,

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General Electric Co.'s NEW X-RAY TUBE

With Automatic Vacuum Regulator.

No more Troubles from High Vacuum Tubes.

SIMPLE AND EFFICIENT.

Keeps Vacuum Adjusted Automatically. Can not run too high in Vacuum for Operation. Life practically unlimited.

Roentgen-Ray Exciting Apparatus: Thomson Inductoriums, Thomson Roentgen-Ray Transformer Sets, Fluoroscopes, etc. Catalogue No. 9050.

Miniature Lamps: Candelabra, Decorative, Battery and Series. Catalogue No. 9044.

Edison Decorative and Miniature Lamp Department,

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WATER WHEELS

TURBINE WHEELS, for Heads of 3 to 220 feet.

CASCADE WHEELS, for Heads of 50 to 2000 feet.

Suited to all Water Power Purposes.

Pamphlet of either Wheel sent free. State your Head.

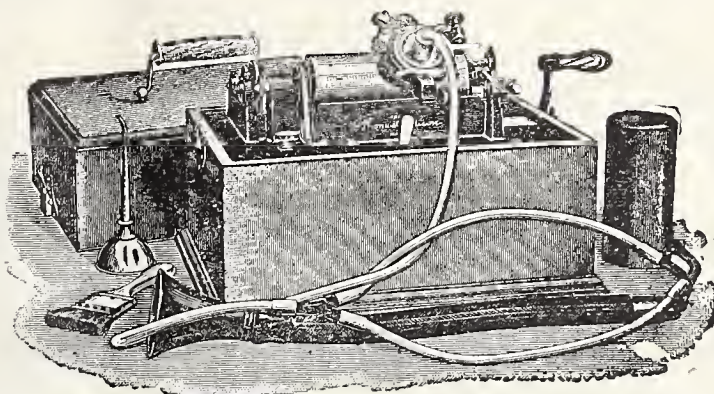
JAMES LEFFEL & CO. Springfield, Ohio, U.S.A.

EDISON'S NEW STANDARD PHONOGRAPH.

EVERY FAMILY SHOULD POSSESS ONE.

Records Reproduces, shaves off cylinders, has sapphire points. Runs 3 records with one winding of spring. Weight, 17 lbs. Complete, as per illustration,

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RECORDS

are the best, loudest, clearest.

All the latest songs and music, 50 cents each, \$5.00 per doz.

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Catalogue and Price List of Everything Manufactured at Edison's Laboratory furnished on Application.

EDISON PHONOGRAPH AGENCY, EDISON BUILDING,
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ROCKING GRATES. DUMPING GRATES.



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**THE BEST AND CHEAPEST
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FOR ANY KIND OF FUEL.

W. W. Tupper & Co.,

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Gas Lighting by Electricity.

Static Electric Machines and Burners for the Multiple System.

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MANUFACTURER,

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TRIO BUILDING.



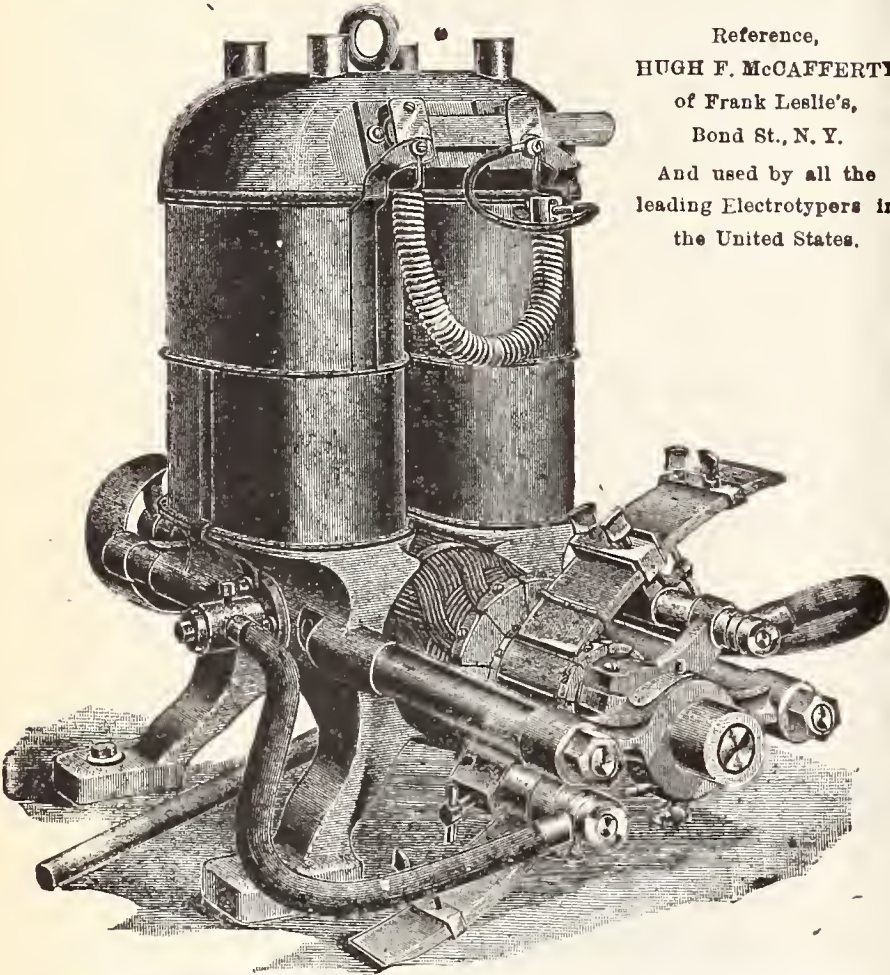
THE WORLD DYNAMO

WILL PRODUCE A SHELL IN 30 MINUTES.

Manufactured by the

ARNOUX & HOCHHAUSEN ELECTRIC CO., 478 & 480 PEARL ST.
NEW YORK.

Reference,
HUGH F. McCAFFERTY
of Frank Leslie's,
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And used by all the
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the United States.



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*SWITCH BOARDS,
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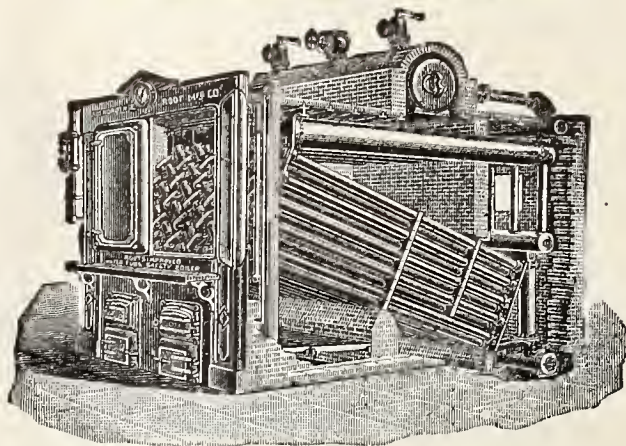
STATE ST. Cor. BOERUM PLACE,

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THIS IS THE BOILER

ROOT IMPROVED WATER TUBE BOILER.



Selected by leading Electric Light Plants and Street Railway Companies throughout the United States. The following are the acknowledged requirements in water-tube boilers: *Straight tubes which can be thoroughly inspected and cleaned inside and outside; perfect suspension, allowing free movement of whole boiler expanding and contracting; perfect flexibility for the difference in expansion between upper and lower tubes; interchangeable parts, built to fixed standards; facilities for making quick and easy repairs which can be done by your own engineer or machinist; a cover joint which can easily be made tight, and frequently broken and replaced without injury; provision made to introduce the feed water where it will not chill and moisten the steam; provision made to carry feed water impurities direct to the mud drum and not past the ends of the tubes; provision made to supply the lower tubes with a bountiful supply of cool water; the use of the best materials and fittings the market can afford; the best possible workmanship; a large disengaging surface for the steam to escape from the water; small cast iron pressure parts; ample heating surface to prevent injury to parts should boiler be forced above its rating.*

Examine these Points in the Improved Root Water-Tube Boiler.
Send for our Illustrated Catalogue.

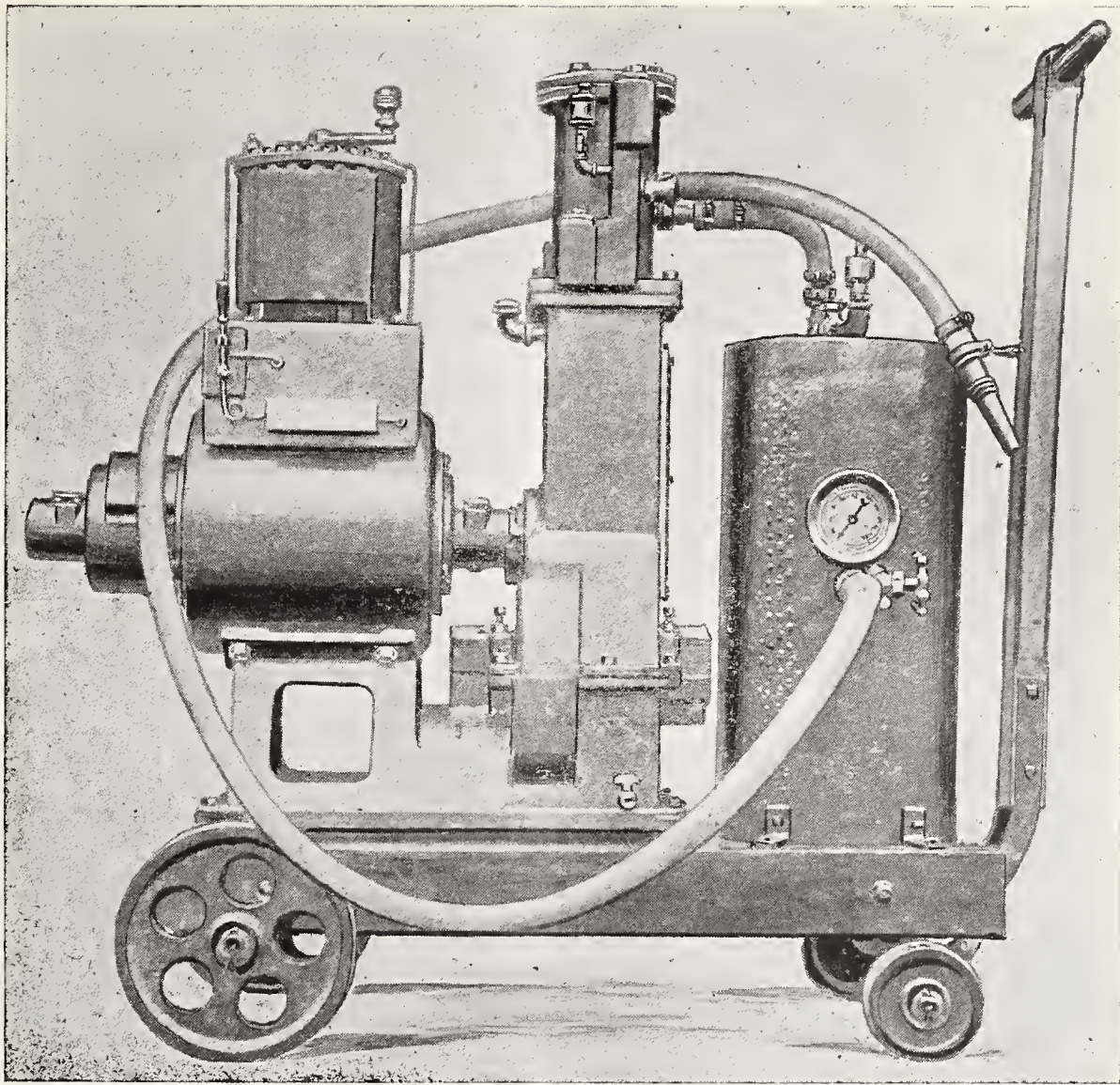
**ABENDROTH & ROOT MFG. CO., 28 CLIFF ST.,
NEW YORK CITY.**

The Electrical Age.

VOL. XXII—No. 9

NEW YORK, AUGUST 27, 1898

WHOLE No. 589



New Portable Air Compressor, Belt or Motor Driven.

THE HUNT AIR BRAKE SYSTEM.

The phrase "up-to-date" is merely one exemplifying a state of mind or grasp of conditions which shows an inherent desire to be modern, alive, awake to the requirements of the hour. Since the public have expressed their belief in the advisability of having as much rapid transit as possible, the Hunt Air Brake Company, of New Kensington, Westmoreland County, Pa., have developed a system of braking street cars which possesses many unique characteristics and represents in every respect that "up-to-date" quality previously defined. The control of a car in a ready and efficient manner by means of air pressure or by mechanism operated thereby is so great a necessity at present that the adoption of this system for street railway purposes was a pressing necessity to all.

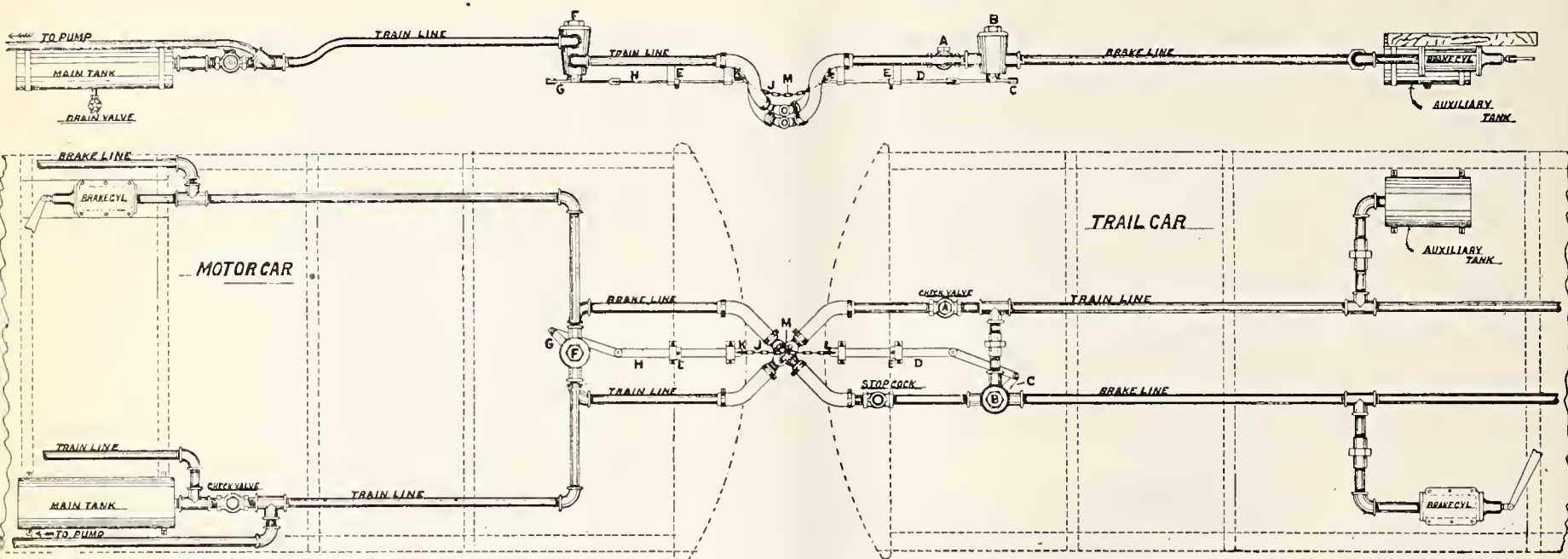
From a technical standpoint, the Hunt air brake consists of these parts: A pump furnishing compressed air, a reservoir for its reception, an automatic regulator controlling the pressure of air in the reservoir, a three-way valve regulating the flow of air from the reservoir to the brake cylinder; the pressure gauge, indicating the tension of the air in the reservoir; a brake cylinder operating by means of its piston rod upon a lever which sets the brake, an eccentric attached to the car axle operating the pump and by this means keeping up the air supply, and a hose used for connecting on to trail cars. In the illustrations appended to this article are shown a special form of portable air compressor used for rather a different purpose, but representing interesting features of construction to which reference will be made later on.

This air compressor is used for general pneumatic work. Possibly the piece of apparatus possessing the greatest interest to the electrical engineer is the automatic pressure controller, by means of which the air pressure entering the reservoir is absolutely controlled and the motor on the car protected from sudden rises of pressure. This is possible in this device by allowing the resistance to be gradually cut out every time the compressor is started. This controller is the only one in existence which automatically interferes, protecting the motor in case the trolley slips off or the current be discontinued while the compressor is in operation. The automatic pressure controller is adjustable for any pressure, breaks the circuit at two points instantaneously, is equally serviceable for automatic or straight air, and requires no attention from either conductor or motorman.

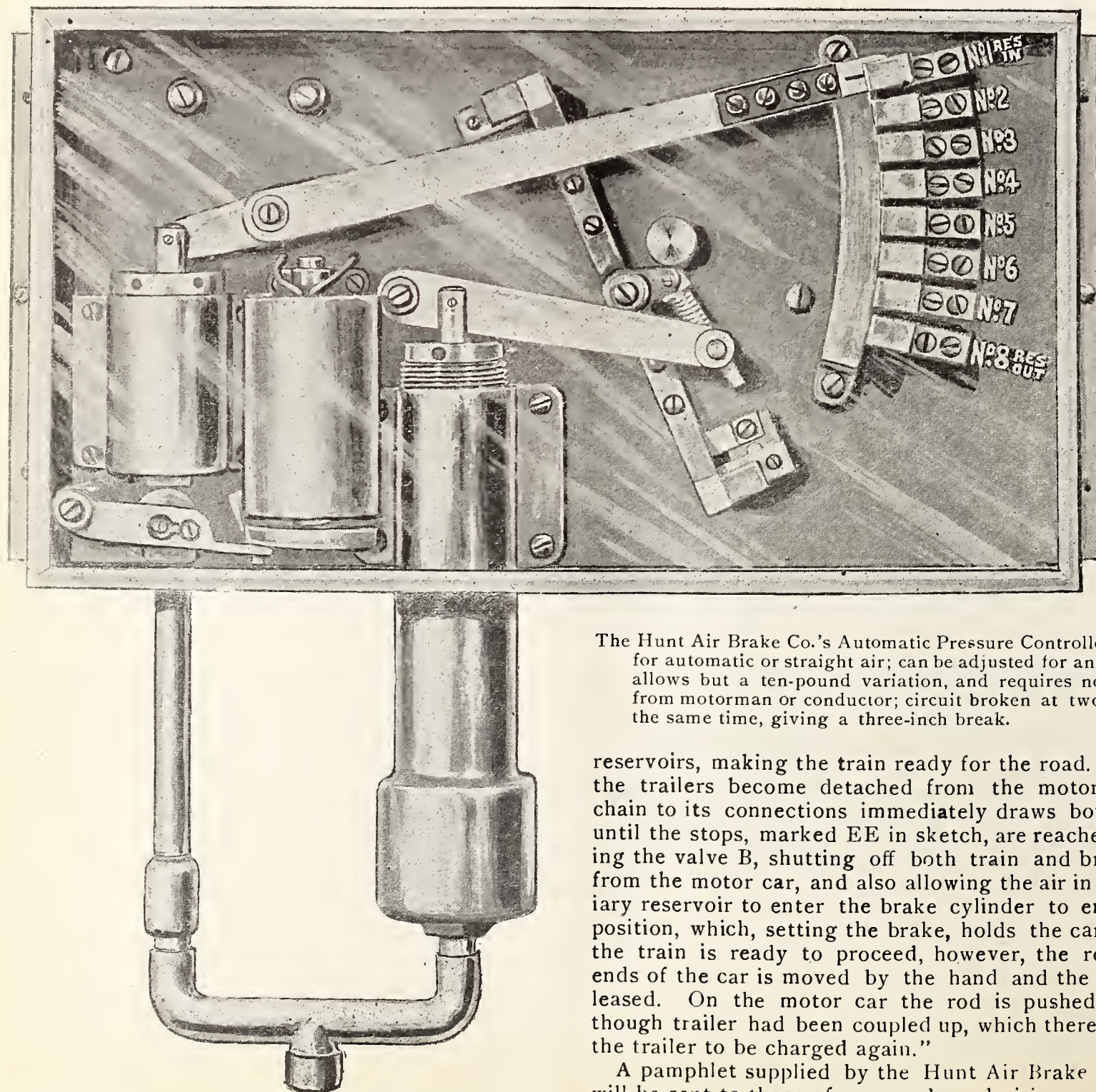
The air compressor finds its use for power house station cleaning. It is driven by a motor taking two hundred and fifty volts pressure, or higher or lower to suit. A steel tank two feet high registers pounds per square inch. The pump has a four-inch cylinder, four and a quarter inch stroke, and is operated by a two-horse power series-wound motor. The air supplied by this machine may be led to the commutator of the dynamo or used for whatever purpose required. In the illustration the compressor of the series B type is mounted upon a wood frame with iron axles and wheels. The vertical reservoir is firmly bolted. Vibration cannot be taken up, and no mistake is possible in connecting motor up, as the binding

posts are stamped positive and negative. All moving parts operate in oil, and everything is ironclad. About ten feet of hose is all that is required to operate this device.

them from the motor car. The value of this combination is evident to our readers. To quote, the operation of the system is as follows: "After the train has been made up and coupled the compressor is started, charging both



The Hunt Air Brake Company's New System for Automatically Setting the Brakes on Trail Cars should they Become Detached from the Motor Car.



The Hunt Air Brake Co.'s Automatic Pressure Controller; adapted for automatic or straight air; can be adjusted for any pressure; allows but a ten-pound variation, and requires no attention from motorman or conductor; circuit broken at two points at the same time, giving a three-inch break.

reservoirs, making the train ready for the road. Should the trailers become detached from the motor car, the chain to its connections immediately draws both valves until the stops, marked EE in sketch, are reached. Opening the valve B, shutting off both train and brake lines from the motor car, and also allowing the air in the auxiliary reservoir to enter the brake cylinder to emergency position, which, setting the brake, holds the car. When the train is ready to proceed, however, the rod at the ends of the car is moved by the hand and the brake released. On the motor car the rod is pushed back as though trailer had been coupled up, which thereby allows the trailer to be charged again."

A pamphlet supplied by the Hunt Air Brake Company will be sent to those of our readers desiring a more detailed account of this system than our space will allow.

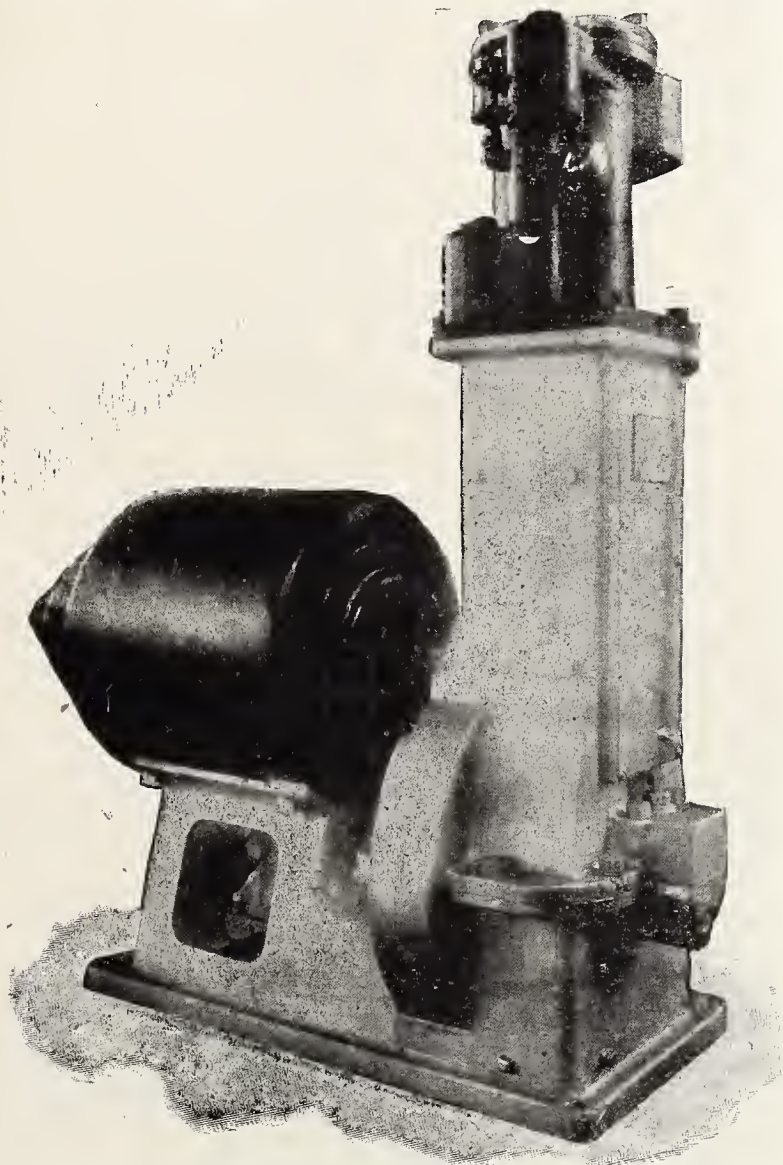
The combined motor compressor illustrated herein is

The diagram represents a new system for automatically setting the brakes on trail cars in case accident detaches

used for heavy, double-truck electric cars. It is carried upon a platform or vestibule, or partially suspended below the floor line, if necessary. The pressure of air in the reservoir is absolutely controlled by the automatic controller. The size of the compressor is thirty inches long, twelve and one-half wide, and thirty-four inches high. The series B type delivers eight cubic feet of free air per minute; series E, eleven and one-half; series C, thirteen; the weight and size of each being about the same. A rather larger size called series D is used for special purposes, such as those requiring automatic air, etc. A delivery of thirty cubic feet of free air per minute is possible in this case.

A car controlled by this apparatus is one which may be almost instantly stopped, and is safer to the pedestrian at a high speed than those equipped with ineffective devices running at a lower speed.

It is not necessary to dilate further upon the advan-



Combined Motor Compressor Furnished for use Either With "Straight" or "Automatic Air."

tages of an ever-ready and accident-preventing brake, but it is well to point out that system and mechanism which seems to represent in its embodiment those desirable features of definite value and immediate application. The subject of air brake and mechanism related to it is an extensive one, but in spite of the scientific attention it has received, the development of the art of air brake manufacture has only lately attained its maximum. It is fortunate that such is the case, for in the near future our cars will fly through the city limits, and the necessity for a system of braking as herein described will be, as it is today, a crying one.

THE LIMITATIONS OF GOVERNMENT IN WATER-POWER PLANTS.

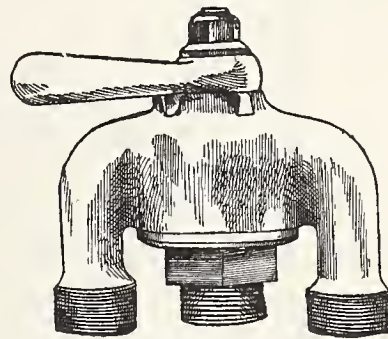
BY MARK A. REPLOGLE, ENGINEER.

The regulation of the speed of a water-wheel in a power plant is determined by four distinct factors:

1. Changes in load or requirements for power;
2. Time required for gravity to generate power;
3. Capacity of the plant for stored energy; and,
4. The governor or mechanism that should automatically combine the above three factors in such a manner as to obtain even speed or good regulation. These factors, clearly defined, are bases from which intelligent calculations can be made showing the possible efficiency of government in any water-power plant.

Let it be understood that the word "government" refers to that regularity of motion or speed that is so desirable and necessary in our finest manufacturing and electrical power plants. Absolutely uniform speed can be maintained only when there is no change in the power supply and no change in the friction or work of the plant; but if the above factors are carefully considered and judiciously manipulated or applied, the variations of speed may be so reduced that the results can be called perfect government.

The speed of a plant at all times is a resultant of opposing forces establishing an equilibrium or balance. The power supply has a tendency to increase speed and the work has a tendency to decrease it. Speed may be varied by increasing the power supply or by decreasing the power supply; by increasing the amount of work performed, or by decreasing the amount of work performed; and any one of the above changes causes instantly a change in the speed; but the amount of change in speed depends entirely upon the amount of change in load, the time it takes gravity to generate power, the quantity of



Hunt Air Brake Co.'s Three-Way Valve.

energy in store, and the operation of the governor in opening or closing gate.

Since it is impossible for any automatic governor to change the power supply at the instant a change has been made in the load or work of a power plant, it is very plain that there must be fluctuations in the speed. The problem of government is to narrow these fluctuations to such an extent that the speed will be constant as far as practical operation is concerned. The finest government ever obtained consisted of changes in speed, but within narrow limits. The speed of a well-governed single-crank engine changes four times every revolution.

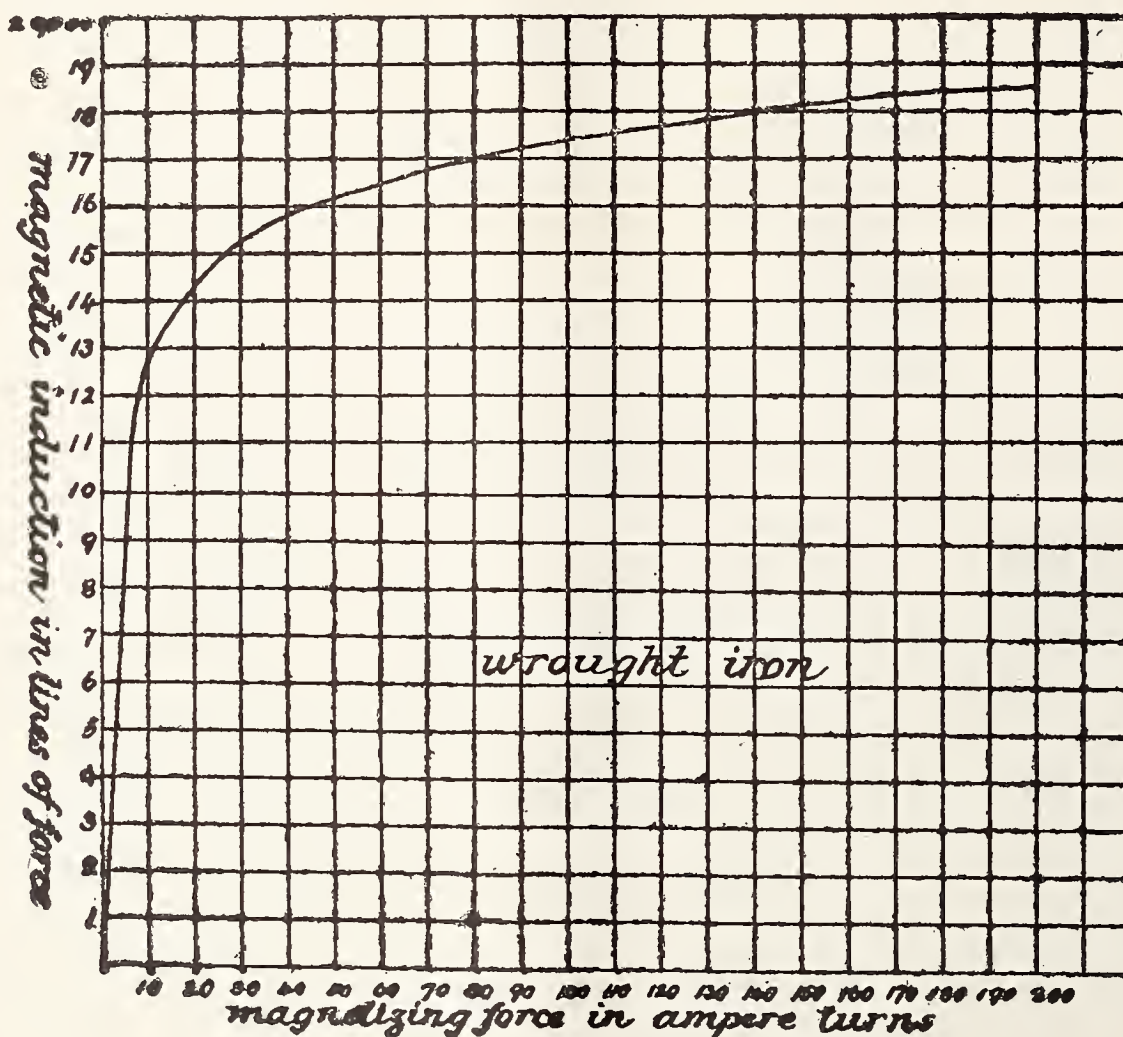
The first factor in governing, "the changes in load," is a variable one, and is limited only by the character of the work done by the water-wheel. The changes may range from zero to the full power of the wheel instantly, making government a more difficult problem than it would be if the changes were limited in number or quantity. It is plain that if an even speed is retained when a change in load is made, there must be at the same instant a corresponding change in the power supply. This is an impossibility in automatic governing, for several reasons: the speed must change in order to inspire the speed governor; following this, the speed governor causes the valve or gate-moving mechanism to operate, which operation requires time; and, again, it requires time for gravity to overcome the inertia of the increased quantity of water that must pass through the wheel before an increase in power can be had. During all this time, the speed of plant has been decreasing if the load was increased, or increasing if the load was decreased, and the amount of change in speed depends entirely upon what

ratio the change in load bears to the stored energy in the moving parts of the plant. A heavy change in load will of course cause a greater change in speed before the power supply is changed, than a light change in load. The problem is, therefore, to proportion properly the power-storage to the changes of load that must be imposed upon the plant, because this power storage, or the capacity to store power, must take care of all changes in load until the power supply, or gravity effects, can compensate for said changes.

The second factor, "time required for gravity to generate power," is more constant than the first. In fact, the limits are established in the construction of the water-power plant, and, of course, remain so. The point we wish to emphasize most in the time requirements is the inertia and momentum effects of the water.

It is well known that water has practically no elasticity; hence, if enclosed in a long pipe, the whole body must be put in motion at the same time. If the pipe or flume consists of several hundred feet of horizontal length and only a few feet of vertical pipe or "head" which alone gives gravity effects on the wheel, it is a similar proposition to the locomotive and train of cars. It is very evident, then, that long horizontal pipes should be avoided in order to reduce to a minimum the time required to get gravity effects, because the speed of water-wheels will keep changing, after a change in load, until the effects from gravity can correct it in the power supply.

Gravity effects at best are very slow as compared with steam, and for this reason a water-power is handicapped in the matter of government. The logical conclusion is, that in water-powers the water or power supply should all be



Magnetization Curve of Wrought Iron.

A locomotive can propel a train of cars at a rapid speed; but it takes time to acquire such speed. When the locomotive has brought enough pressure to bear upon the train, it moves, at first slowly, but keeps increasing in speed often many seconds before it reaches full motion. The locomotive may be limited in strength to 250 H. P. per second. The train in full motion may represent 25,000 H. P. for a second. In such case, it will take the locomotive 100 seconds to bring the train to speed if we do not consider the frictional losses. Water has no power in itself; but must be put in motion by gravity in the same manner that the locomotive starts the train of cars, and a long train of water acted upon by a constant gravity effect, is put in motion in the same manner that the train of cars is by the locomotive. It is plain, then, that the time element must be considered in the government of water-power. The water-wheel cannot furnish power until it brings to rest the water to which gravity has given motion, and it can receive no power from the water until the water has sufficient motion for the moving wheel to retard. It is also plain that there must be changes in the flow and velocity of water for every change made in the load of the water-wheel; also the change in the flow of water must occur before there can be a change in the power supply.

under the direct action of gravity and move in line with it. This reduces the time necessary to furnish increased or decreased power to the shortest limit.

DESIGN OF ELECTRO-MAGNETS.

To produce in a given cross section of iron a certain specific induction is one of the commonest practices in electrical engineering. The line of force spoken of in this case differs quantitatively from the line of force whose course is shown by iron filings. All lines of force are of equal value, but those lines represented by magnetic curves vary from each other in many respects. It is not a difficult matter to determine the size of wire and number of ampere turns required to make a magnet suited for practical work. Always allowing a specific induction in steel of eighty thousand lines of force per square inch, a specific induction in wrought iron of one hundred thousand lines of force per square inch, and a specific induction in cast iron of fifty thousand lines of force per square inch, we find that we need thirty-four ampere turns per inch length for cast steel, ninety-one ampere turns per inch length for wrought iron and one hundred and sixty ampere turns per inch length for cast iron.

The original Hopkinson curve for wrought iron per square centimetre is given below. Its use is obvious. An electro-magnet built to carry five amperes having a core cross section of ten square inches and a length of five

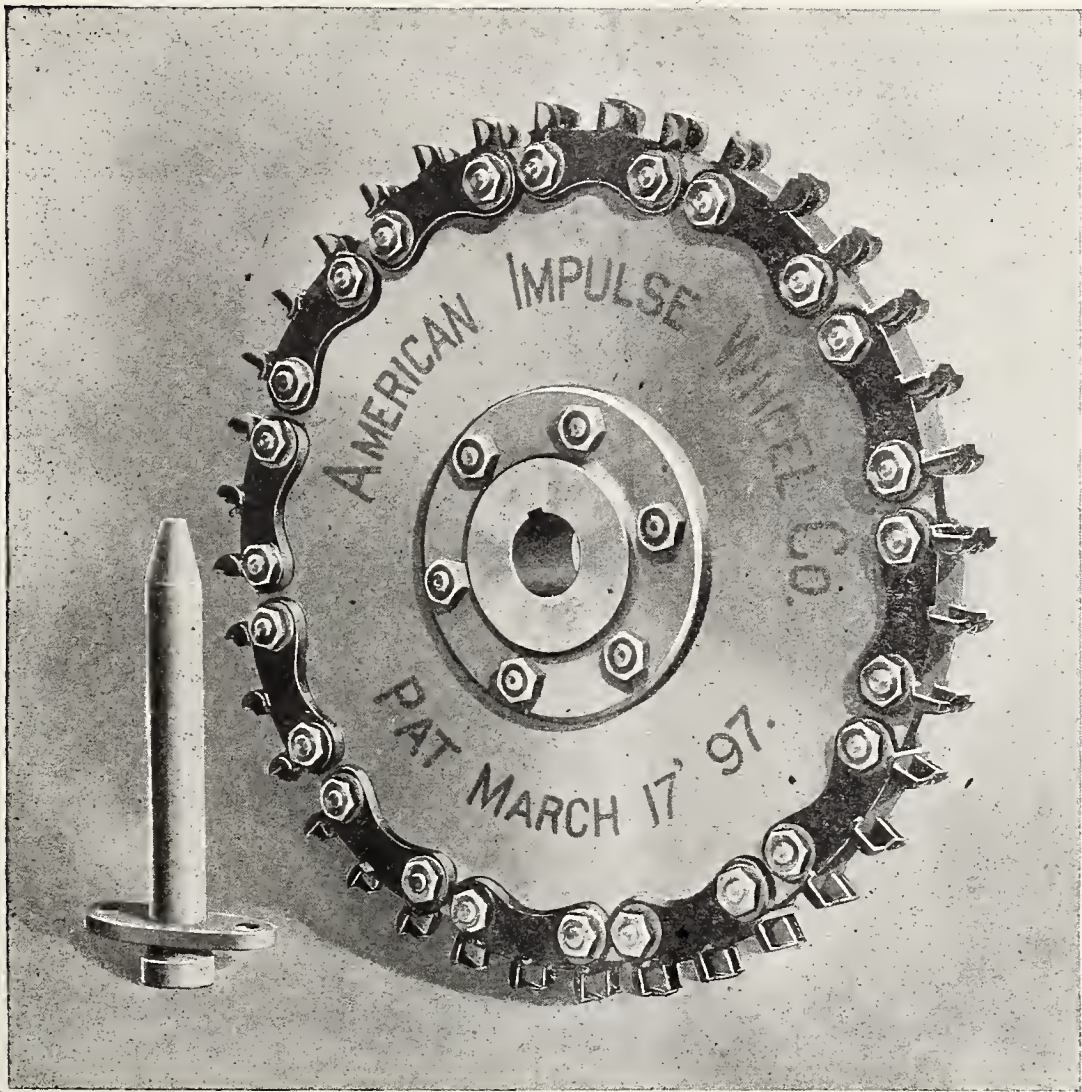
duce one million lines of force in the core. Although this subject is capable of more detailed expansion, the important points to be observed are sufficient radiating surface or an allowance of two and one-half



Measurement of Streams.—Weir Dam Method.

inches would be handled in the following manner: The core being of wrought iron saturated will carry one hundred thousand lines of force per square inch, or ninety-one ampere turns per inch length. As the core is five

inches per watt, the required number of ampere turns to bring the lines of force through both armature and field as well as air gap, and a selection of a wire whose size will limit the resistance, consequently, the current and



Special 18-in. Steel and Phosphor-Bronze Wheel, Used Under 700 lbs. Pressure.

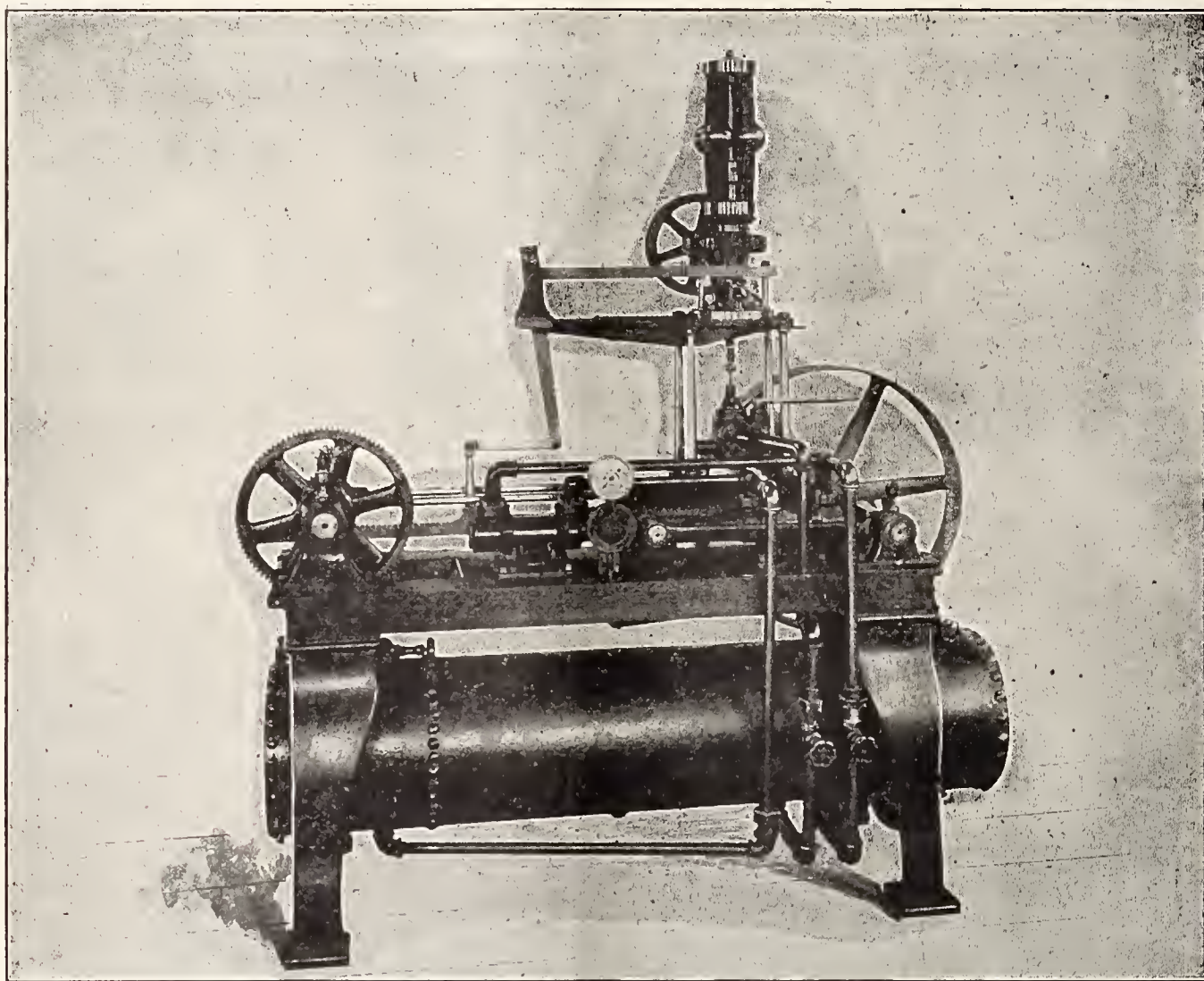
inches long, four hundred and fifty-five ampere turns are required. Allowing one thousand circular mils per ampere, five thousand circular mils will be used, giving a size of wire equal to No. 13. The turns are equal to four hundred and fifty-five divided by five, equalling ninety-one. The general features presenting themselves result in the conclusion that ninety-one turns of a No. 13 B. & S. will supply magneto-motive force enough to pro-

heat waste, to its proper value. The amateur designer, whose line of reasoning does not embrace all details, will always find it convenient and save time to allow one thousand circular mils per ampere in his wire and a radiating surface of at least two and a half square inches per watt. At some future date a complete series of articles will appear in these columns treating of the design of a

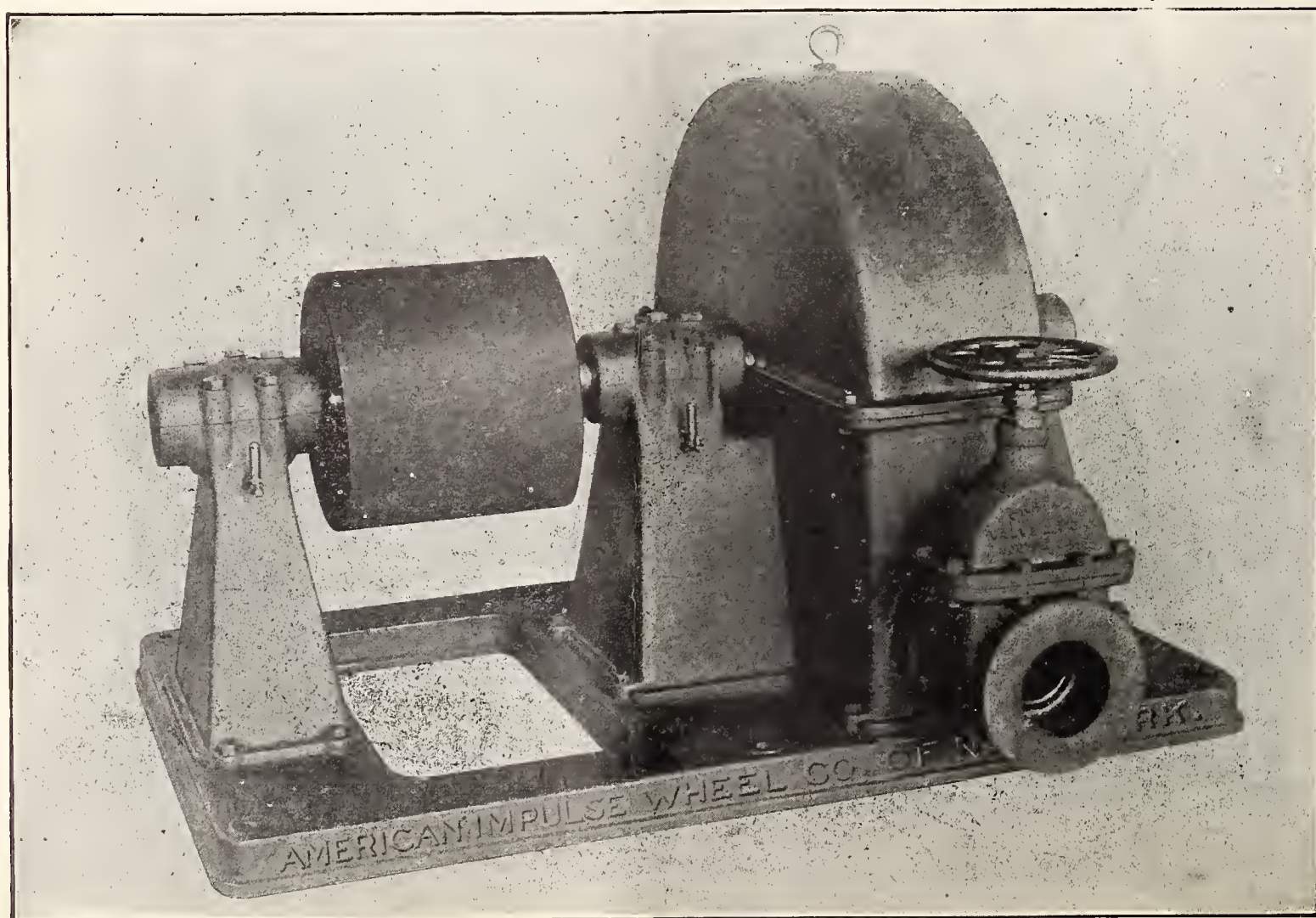
dynamo in a simple and comprehensive manner, in which no more complex mathematics will be required than those involved in the use of addition, subtraction, multiplication and division.

IMPULSE WATER WHEELS.

The subject of water wheels has been of the deepest interest to mankind from time immemorial. The wind



Lombard Governor—Type A.



Standard 36-in. Wheel, No. 5.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

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NEW YORK.

NEW YORK, AUGUST 27 1898

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ELECTRIC RAILROADS IN CHINA.

The Celestial Empire is beginning to break away from its ancient practices and forgetting its time-honored traditions. Surrounded as it is by a wide circle of civilized nations, it is succumbing to their influence and betraying an interest which threatens to become an anxiety to march to the front ranks and occupy a place with others in the vanguard of progress. The foreign devils are soon to meet with gratitude from the Chinese, instead of suspicion, and the sea of ignorance in which this race has lived for ages untold will be agitated to its uttermost depths by a new force proceeding from civilized sources. The city of Shanghai is about to have installed in it an electric railway. It will be eighteen miles long and represent the ordinary type of trolley road. The city council have drawn up a report of their proceedings, as follows:

The report of the special commission is again under discussion and it is decided to include in the particulars both systems of gauge ("standard" and "meter").

The following general particulars are ordered for publication:

The electric overhead trolley system is to be adopted. The routes are to be three in number, viz:

(1) From the French water works along the Chinese Bund (if practicable), and thence along the French and English Bunds, to the point by way of Broadway, Seward, and Yangtzepoo roads.

(2) From the Bund to the Bubbling Well, by way of the Kiukiang, Kiangse, Hankau and Nankin roads.

(3) From the Shanghai station of the Woosung-Shanghai Railway to the west gate of the Chinese city.

A concession is to be given for the construction of the line and all accessories to a syndicate or company, to be known as the "Shanghai Tramway Company." The concession is to be for thirty, forty, or fifty years, according to the tender that the ratepayers may decide to accept, and the company is to pay the council a percentage of

the total gross receipts for the period of the concession.

Notification to tenderers by public advertisement will follow in due course, and the tender finally accepted will be submitted to the ratepayers for ratification.

We can certainly feel that with the installation of this road in Shanghai immense commercial possibilities open up to the manufacturers of America and England. We have frequently noticed that the first real taste of civilization in the way of innovations is intoxicating. A feverish desire takes hold of the people, as in the case of the Japanese, to have everything new, and we anticipate the same in relation to China, whose capacity for improvement is almost immeasurable. American manufacturers, with their wonderful facilities for turning out high-grade machinery, will discover in time a field for their goods which may make them strain every nerve to keep pace with the demand.

The producing nations have been supplying each other in the past, but the time has arrived for them to turn their attention to a land populated by nearly one-half the world's inhabitants, a people in whose breasts a love of the new is beginning to grow, which, if properly cultivated, will cause a social reform of an extent hitherto unequalled in the world's history.

AMERICA SUPERIOR IN THE MECHANIC ARTS.

One effect of the Spanish-American war has been to give Europeans a better knowledge of the ability of the United States to manufacture instruments of precision. American watches and clocks have long been regarded as marvels of correctness in time keeping; but, as was recently stated by a leading Frenchman, "America has astonished the world with the accuracy of her implements and machinery; her steel ships resist and endure better than those of other and older countries. Her intricate machinery does not get out of order so quickly and stands crucial tests far beyond the power of European apparatus, and there are fewer failures, because there are fewer defects; this is due to her implements of precision." It would be well to take advantage of this reputation and show what can be done by the American workmen; especially in the line of engines, locomotives, tools for cabinetmaking, all sorts of die-cutting machinery, and machines used in the manufacture of firearms of all classes. As France is seeking more and more to do her own manufacturing, she will naturally turn to the country that can sell her the best machines to accomplish her aims. These kinds of machinery should be well represented in France at all exhibitions.

A careful study should be made, not only of the needs of the French market, but of the best and quickest way of meeting them.

As has often been stated, the best man to do business for America is an American speaking the native tongue of the country to which he is sent. He will do more in less time, and do it more satisfactorily, than any foreigner.

Walter T. Griffin,

Limoges, July 19, 1898.

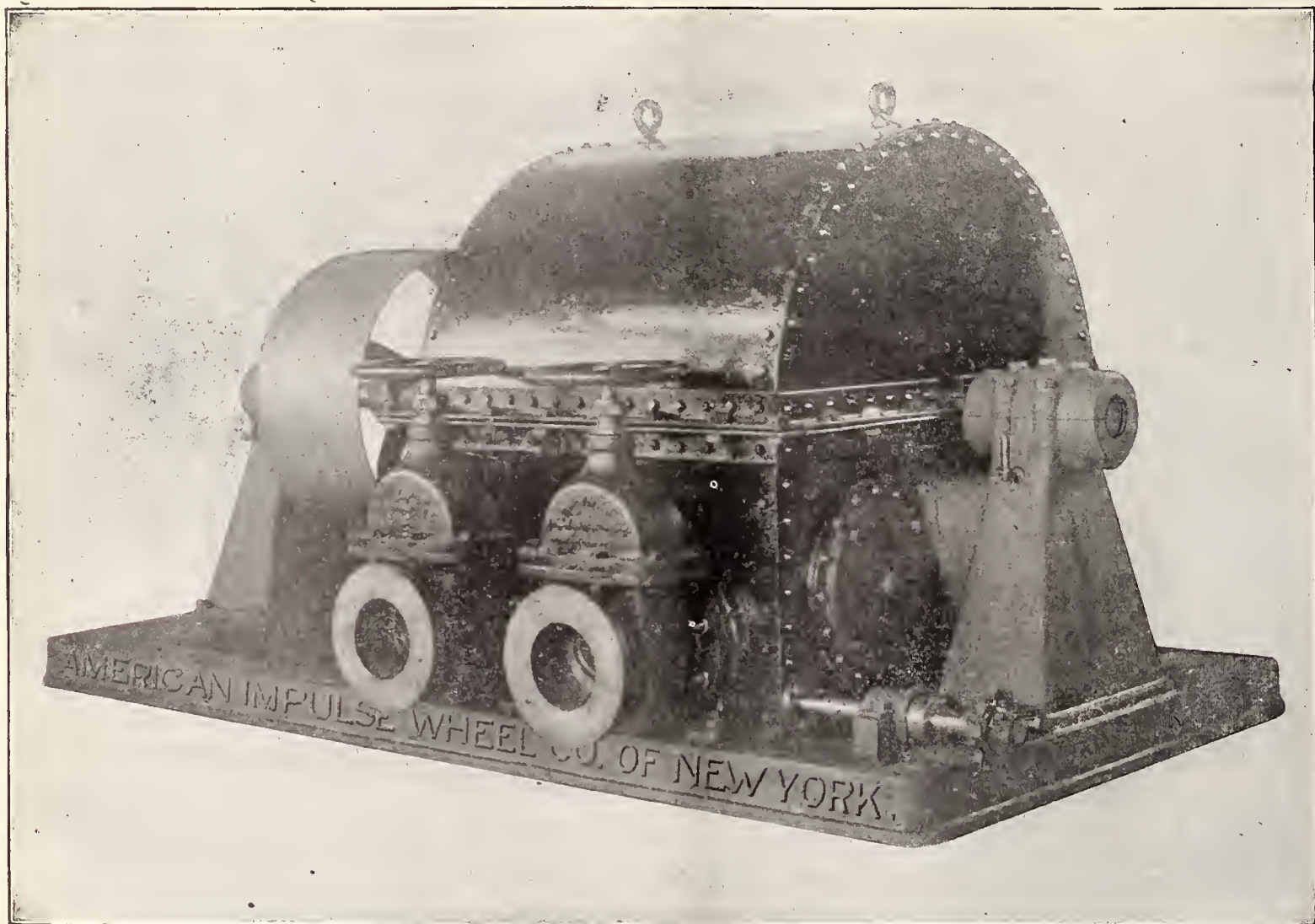
Commercial Agent.

DEMAND FOR COAL BY BRAZILIAN GOVERNMENT.

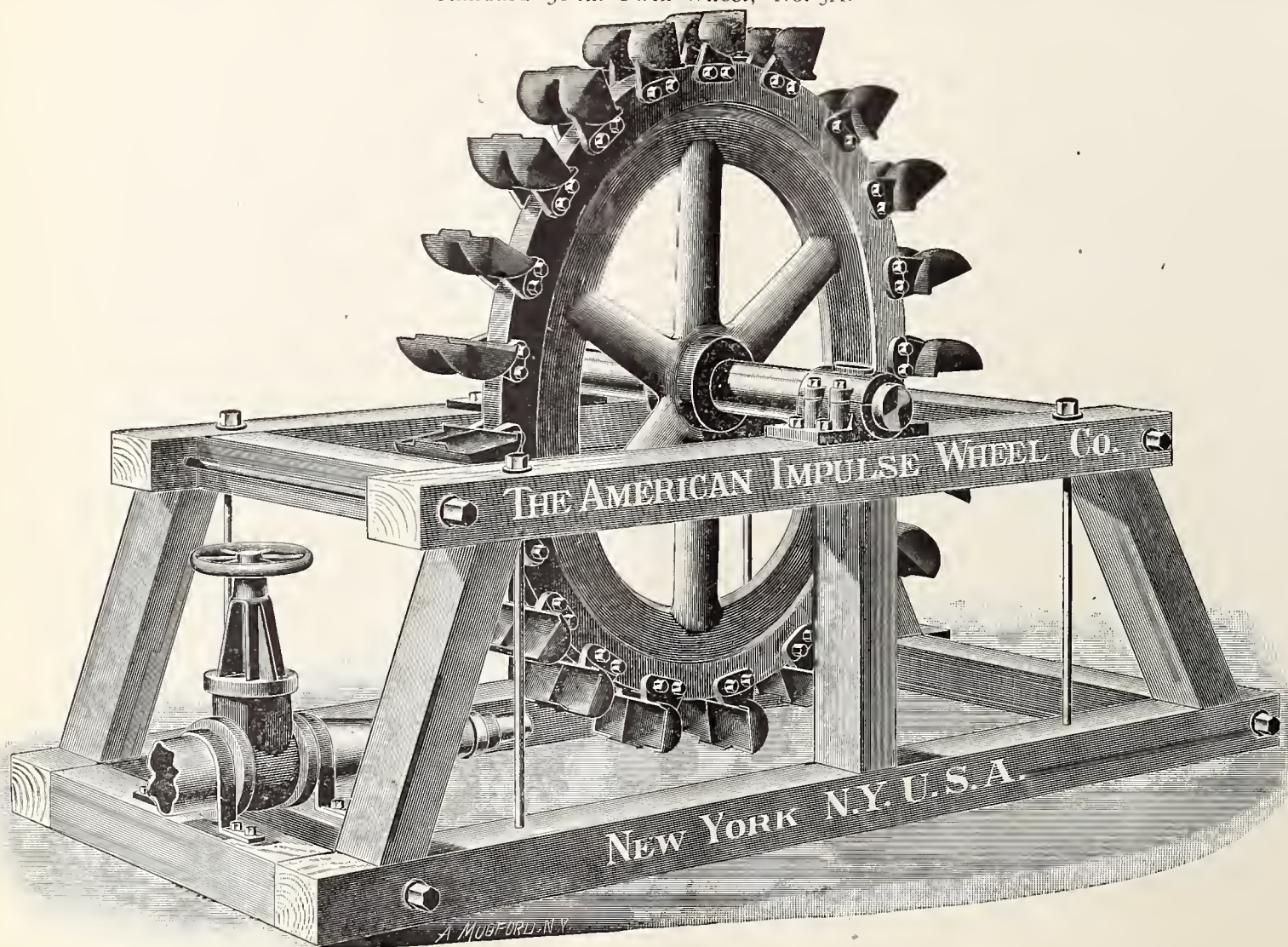
The Department has received a cablegram from Minister Bryan, dated Petropolis, August 8, 1898, to the effect that the Brazilian Government intends to advertise for 120,000 tons of coal bids to be opened in October. Mr. Bryan desires that United States exporters should be informed of this opportunity.

mill of Holland, the water wheel of Switzerland, have exercised a wonderful influence over the commercial life

stimulus can be traced in thousands of cases To the scientific observer power abounds on all sides, in the



Standard 36-in. Twin Wheel, No. 5A.



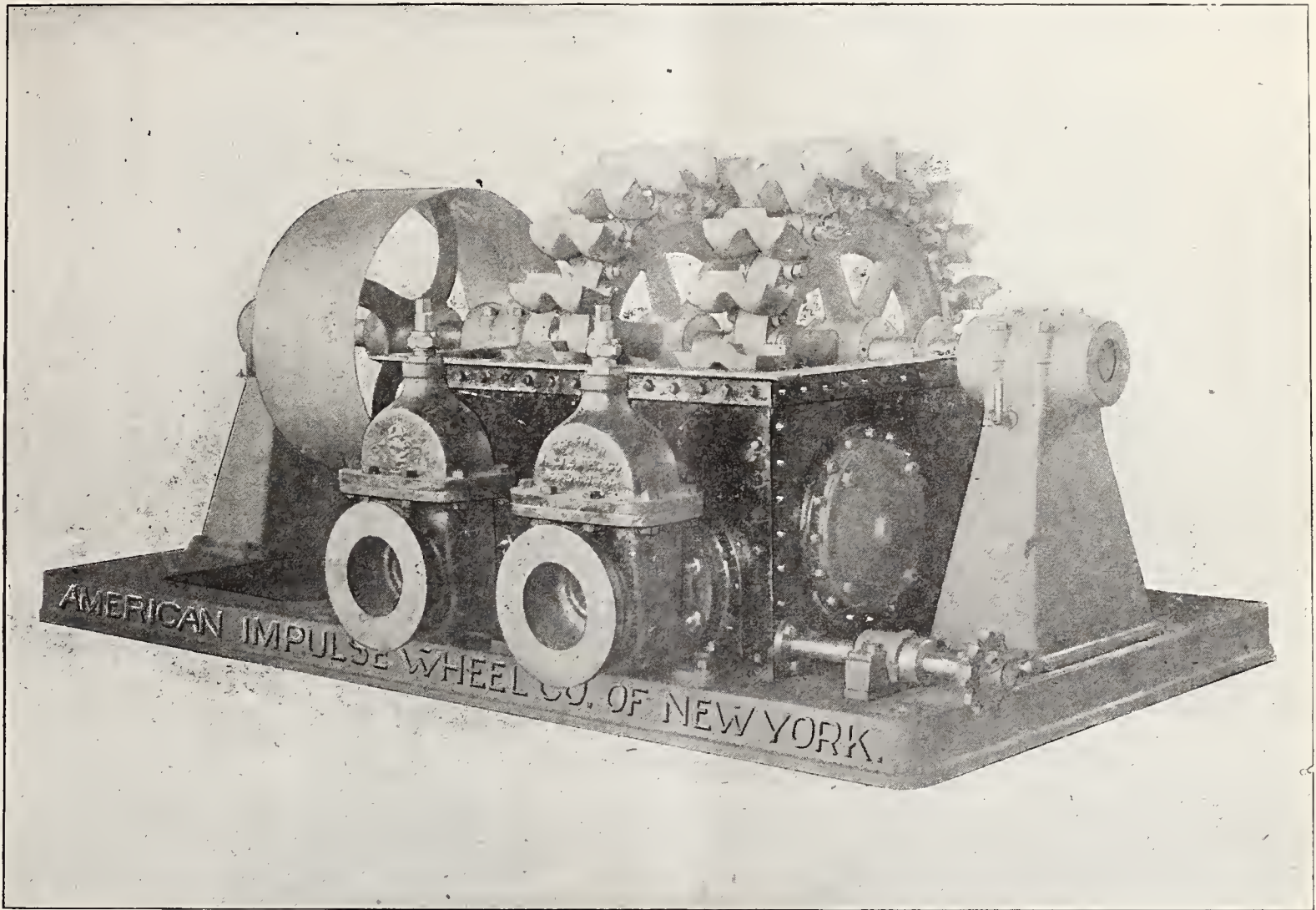
Single Nozzle Wheel Without Housing.

in those countries. The influence of the water wheel in developing industries lying latent for want of the proper

winds, the tides, and particularly in streams of running water.

The water wheel industry represents the natural outcome of efforts made to turn this natural force to good purpose; to transform the kinetic energy of a waterfall into another force better adapted to manufacturing purposes than the unbridled and useless power which grinds the rock year after year into impalpable dust. Water

The American Impulse Wheel Company, of New York City, 120 Liberty street, produce that type of water wheel called the "hurdy-gurdy." The advantages of this wheel are very apparent to the technical mind. In all cases where it is desirable to use water power of great head the "hurdy-gurdy" wheel has proved itself by practical ex-



Standard 36-in. Twin-Wheel, No. 5A.

wheels must serve their purpose by fulfilling certain conditions. The purchaser of a water wheel must supply to the manufacturer details regarding the head, quantity, power and speed required and length of pipe line. The

perience the superior of all other types, and consequently has been regarded in the end as the only wheel to be considered under such circumstances. The use of turbines in connection with water power of great head is in



Chesley Electric Co., Hoboken, N. J.—Armature Winding Room.

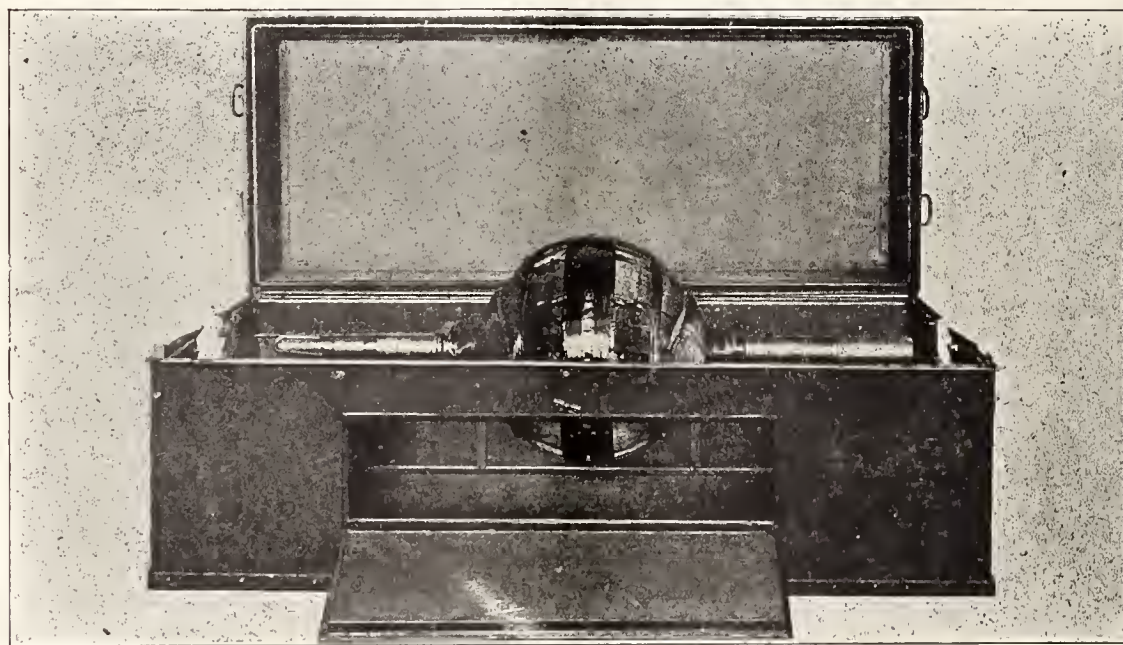
manufacturers of the American Impulse Wheel, in their new catalogue treating of the water wheels manufactured by them, not only point out these facts for the benefit of the intelligent reader, but carefully define the meaning of head, quantity of water, power and speed, etc.

some respects a dangerous practice, on account of the rapid deterioration of the turbine due to the water possessing too much projectile energy.

The buckets of the Cazin impulse wheel represent an original departure from those sold on wheels manufac-

tured by other companies. It might be a point of information for our readers to know that an impinging jet of water does not deliver up its entire energy unless it is received in such a manner that it actually reverses in direction after impact. By the use of projecting knife edges with which the buckets of the Cazin impulse wheel are supplied the stream of water, as it were, is so directed

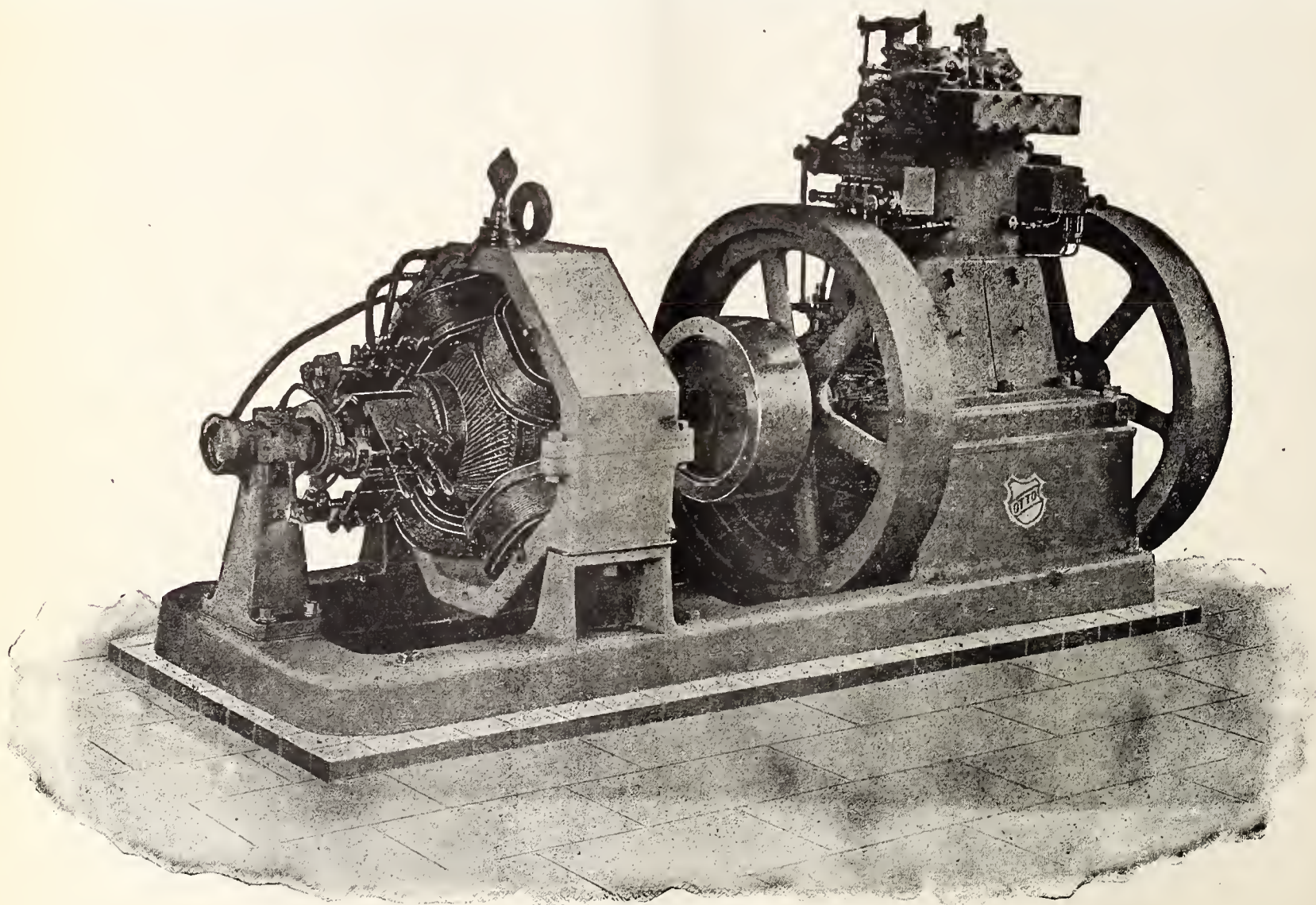
all those communicating with the company at its New York address, 120 Liberty street. Tables are given in this catalogue of the horse power delivered by their different wheels with different heads of water. The regulation of the speed and gate of a water wheel is governed by the mechanism supplied through the American Impulse Wheel Company and called the Lombard water



Chesley Electric Co., Hoboken, N. J.—One of the Drying Ovens, showing Armature in Position.

that it practically curves abruptly and reverses. This feature of construction makes this wheel the superior of other water wheels, enabling it to deliver the mechanical

wheel governor, which they recommend highly for this purpose. For electric lighting, to which purpose most water power plants are used, this governor will be found



A Model Plant.

energy of the falls at a higher rate of efficiency than any other device of a similar nature.

Many prominent authorities have examined into the design of this wheel and spoken of it in terms of the highest praise. Prof. Philip R. Bjorling calls it the latest and best tangential wheel, and all purchasers of it inevitably come to the same conclusion. Catalogues will be sent to

most desirable in connection with the impulse water wheel. The illustrations supplied with this article represent some of the wheels turned out by this company.

The number of installations already made using the American impulse wheel cover a very long list. Proprietors of water still undeveloped should certainly communicate immediately with this concern for advice.

REPAIRS OF ARMATURE, COMMUTATOR AND FIELD.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The dynamo is composed of three important parts, which must receive careful attention each day or they

sustained, or the fact that it is reversed or is otherwise injured.

The repairs of an armature naturally constitute an important department of electrical engineering. Grounds and short circuits make themselves perceptible in ways that can be discovered by testing. A ground, it may be understood, is due to the leakage of current through the insulation, to a great degree, or the touching of the wire against the framework or any metallic part of the machine. A ground may occur in one coil, several coils



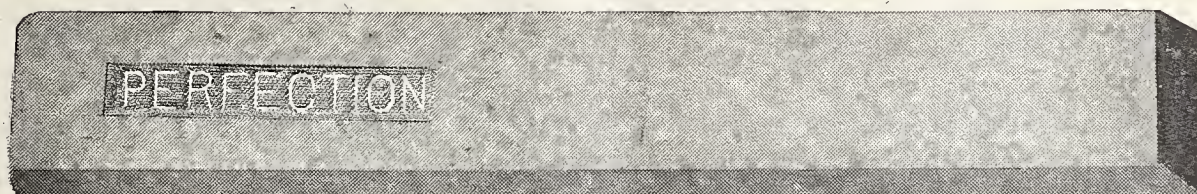
Chesley Electric Co., Hoboken, N. J.—Machine Shop

will be apt to cease operating and destroy the utility of the machine. The armature, commutator and field of a dynamo are the three essential parts which develop peculiarities that sometimes cause the engineer considerable trouble.

associated together or apart from each other, or it may be felt throughout the entire armature. If the ground is in a single coil, that coil will have to be removed if its presence interferes with the operation of the machine. A dynamo will run successfully for years, even though



The Perfection Brush Holder (see next page).



The Perfection Brush (see next page).

The armature is subject to grounds and short circuits which may be local and general, serious or of little consequence, depending upon the style of winding.

The commutator likewise may be loosely put together, have bad insulation or be slowly ground into a shape like a door-knob, due to the pressure of a grinding brush and a choice collection of injurious sparks.

The field may likewise demonstrate its inability to perform its functions on account of a scorching it may have

grounded, without any difficulties whatsoever; but it is in a sense tempting Providence, because a ground on the other side will constitute a short circuit.

There are such things in armatures as insulation grounds due to moisture getting inside, or caused by an alcoholic dampness, due to the fact that the armature has not been well baked. Short circuits, of course, either melt the wire entirely or so burn the insulation that it becomes a charred and blackened mass. If the armature

is of the Gramme type, a coil can be very easily replaced, but if a drum armature it will be a difficult matter to repair a coil without disturbing the others, unless it be on the outside.

The Eickemeyer Motor Company built a machine the armature of which was wound with detachable coils. This made it a very simple matter to remove a coil or coils that became injured. The only way in which a Siemens's armature can be repaired of the ordinary type is to strip off all the coils until that one is reached which is either burnt, grounded or otherwise affected. By using ventilated winding, such as that adopted by the Schuyler Company in the construction of their arc light dynamos, many of these troubles disappear, and the overheating of any given coil does not exert any evil influence upon its neighbors by transmitting heat to them and injuring them likewise. The repair of a coil is carried on in the same way as if it were to be rewound. A test is first made for the ground, if it occurred at any specific point. That portion is taped and the coil completed. The two ends of the coil are then tested for continuity of the metal and then tested for grounds; one end of the coil with the armature core and then the other end likewise. The tinning of these terminals that set into the commutator segments is effected, if possible, without the aid of acids, although if great care is taken to prevent the acid from saturating the insulation it may be used without danger.

Toothed armatures sometimes heat very severely; it is worth while mentioning here that this heat is not always due to the winding, because an armature of this description may be tested by the fingers and it will be discovered that the iron is hotter than the conductors. This is due to a poor design of the teeth of the armature, and the engineer's only remedy, which we would not advise him to attempt, is to bore out the fields a little larger.

The commutator, as we have mentioned, may have a grinding brush. It may spark; it may be filled with poor mica, and the mica, if good, may be oil-soaked. It is a difficult matter to repair a commutator except to turn it down. The sparking may be due to a bad position of the brushes, which the engineer can attempt to remedy. The grounded or oil-soaked mica can have its evil effects removed by carefully baking the commutator, thus drying up the oil and removing that as a source of trouble. But if the mica is causing a ground that cannot be attributed to the oil, the segments will have to be tested in pairs until the ground has been located and the mica causing the trouble removed. Commutators must never be cleaned with emery paper, but fine sandpaper should be used.

If a commutator becomes very hot while running, it is due to the fact that the segments are too small for the current passing. This may occur at the beginning or after the machine has been in use for many years; the commutator in the meantime becoming thinner and thinner at every turning. The only remedy for this is a new commutator. Frequently the use of carbon brushes of insufficient capacity will cause a leakage of the commutator by generating heat within themselves due to the current and friction and transmitting it to the commutator segment. The field is very easily repaired. It may be burnt out, reversed, lack ventilation and therefore heat, have broken connections or become affected by moisture, in addition to the short circuits and grounds that generally affect windings, whether of armatures or fields.

(To be continued.)

THE PERFECTION BRUSH AND BRUSH-HOLDER.

Each of the various manufacturers of dynamos has probably met with the severest trials in selecting a brush which, in his opinion, possesses qualities that rec-

ommend it for practical work. It took a great many years for the technical world to be fully awake to the urgent necessity of supplying dynamo tenders with brushes that were durable and elastic. The history of brush manufacture dates back to rather early times, yet no radical change was instituted in their construction until deteriorating commutators and short-lived brushes made this improvement most necessary.

The Perfection bronze brush manufactured by the Perfection Supply Company, 621 Broadway, New York city, does not abrade the commutator, requires little or no attention and does not excite sparking. It is perfectly flexible and possesses none of those undesirable scratchy qualities which make other brushes notorious, but not famous. This finely constructed brush is made of phosphor-bronze wire gauze, so tempered that it is perfectly fitted for the work it performs. It is made in sizes that range from one-half an inch in width to three, and one-half an inch in thickness to three-sixteenths, being either seven or eight inches long. Special orders are attended to as readily as though goods were in stock. The New York "Herald," Central R. R. of New Jersey, Edison Illuminating Company, Hotel Waldorf, etc., patronize the Perfection Supply Company as well as thousands of others.

The Perfection brush holder, illustrated in these columns, is manufactured by the same concern and represents the strongest and simplest brush holder in the market. The spring never becomes annealed. The holder itself has nothing about it to get out of order. It will last through the seven ages of man and be still as good as new at the end of that time. Its extreme simplicity, ease with which it is set and cheapness, make it highly desirable to the engineering profession. It enables the brush to be used up almost entirely, leaving the shortest kind of a stump behind. The economical engineer will find in it a bonanza, the profession in general a much needed article.

NEW ELECTRICAL INCORPORATIONS AND BUSINESS CHANGES.

Sebastapol, Cal.—G. W. Swain is interested in the establishment of an electric light plant.

Minneapolis, Minn.—The Northwestern Telephone Exchange Co. will increase capital stock of the company to \$4,000,000.

Columbus, Ohio.—The Dayton and Germantown Traction Co. has been incorporated by Fred Shoop, Isaac J. Bassett, Noah Coler, T. B. Meredith and Theo. C. Lindsey; to build and operate an electric railway. Capital stock, \$10,000.



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PORTABLE DIRECT READING
VOLTMETERS AND WATTMETERS
For Alternating and Direct Current Circuits.
The only standard portable instrument of the type deserving this name.

Write for Circulars and Price Lists 8 and 9.

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FROM \$40 A YEAR

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FROM \$90 A YEAR.

An Extension Station

saves time and trouble, insures privacy, adds to the convenience and flexibility of the telephone service. The rate for an Extension Station, to Message Rate Subscribers, is now \$1.00 a month, with installation charge.

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The private Branch Exchange is the proper cure. Many lines are "busy" from 50 to 200 times a day. This is tantamount to turning away business every working day.

A properly designed Private Branch Exchange is never busy.

Stations \$1.00 a month and cost of installation; messages, lines and other equipment at correspondingly low rates.

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TEN CENTS

For a message in Manhattan.

TEN CENTS

For a message in The Bronx.

TWENTY CENTS

For a message passing between Manhattan and The Bronx.

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No increase has been made to the tolls for out-of-town telephone messages on account of the War Revenue Tax.

The Telephone System of Manhattan Island is the Largest Metallic-Circuit System in the World.

Considering the quality of the service furnished, the refinement of the facilities supplied and the cost of maintaining the plant and organization, telephone charges are nowhere in the world more reasonable.

NEW YORK TELEPHONE COMPANY,

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General Electric Co.'s NEW X-RAY TUBE

With Automatic Vacuum Regulator.

No more Troubles from High Vacuum Tubes.

SIMPLE AND EFFICIENT.

Keeps Vacuum Adjusted Automatically. Can not run too high in Vacuum for Operation. Life practically unlimited.

Roentgen-Ray Exciting Apparatus: Thomson Inductoriums, Thomson Roentgen-Ray Transformer Sets, Fluoroscopes, etc. Catalogue No. 9050.

Miniature Lamps: Candelabra, Decorative, Battery and Series. Catalogue No. 9044.

Edison Decorative and Miniature Lamp Department,

(General Electric Co.)

HARRISON, NEW JERSEY.

WATER WHEELS

TURBINE WHEELS, for Heads of 3 to 220 feet.

CASCADE WHEELS, for Heads of 50 to 2000 feet.

Suited to all Water Power Purposes.

Pamphlet of either Wheel sent free. State your Head.

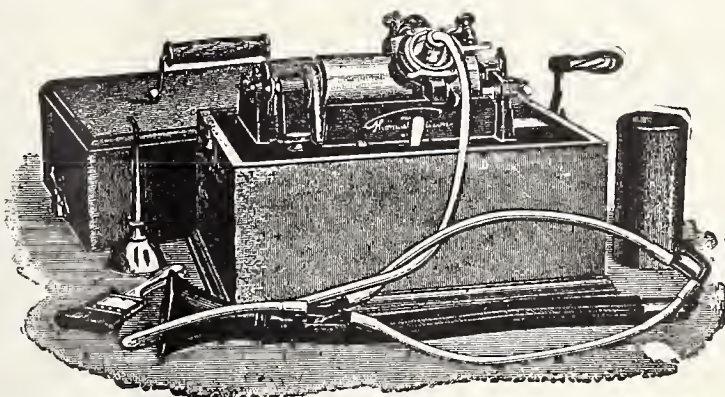
JAMES LEFFEL & CO. Springfield, Ohio, U.S.A.

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\$20.00



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CHARLES H. HINDS,

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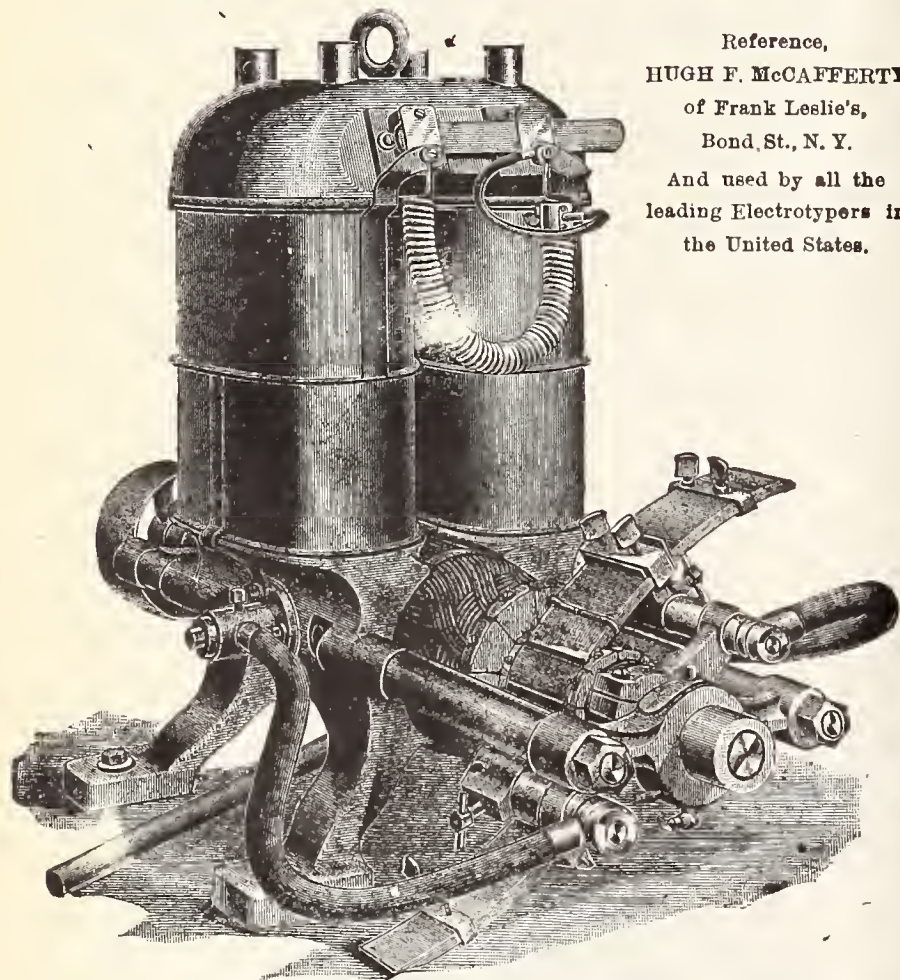
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THE WORLD DYNAMO

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Manufactured by the

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NEW YORK.



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of Frank Leslie's,
Bond St., N. Y.

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leading Electrotypers in
the United States.

H. KRANTZ,

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*SWITCH BOARDS,
PANEL BOARDS,
and SPECIAL WORK.*

WORKS AND OFFICE:

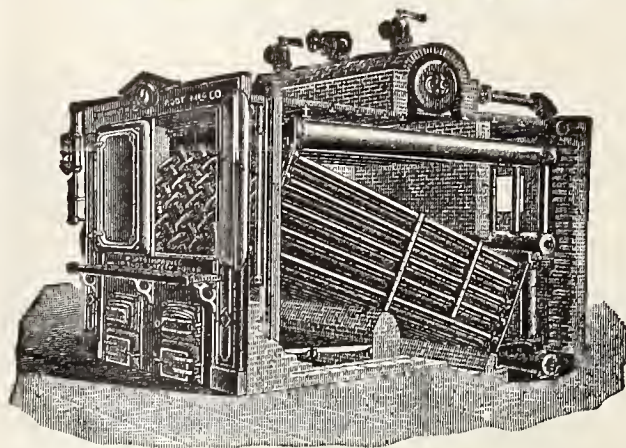
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Ronald Building,

BROOKLYN, N. Y.

THIS IS THE BOILER

ROOT IMPROVED WATER TUBE BOILER.



Selected by leading Electric Light Plants and Street Railway Companies throughout the United States. The following are the acknowledged requirements in water-tube boilers: *Straight tubes which can be thoroughly inspected and cleaned inside and outside; perfect suspension, allowing free movement of whole boiler expanding and contracting; perfect flexibility for the difference in expansion between upper and lower tubes; interchangeable parts, built to fixed standards; facilities for making quick and easy repairs which can be done by your own engineer or machinist; a cover joint which can easily be made tight, and frequently broken and replaced without injury; provision made to introduce the feed water where it will not chill and moisten the steam; provision made to carry feed water impurities direct to the mud drum and not past the ends of the tubes; provision made to supply the lower tubes with a bountiful supply of cool water; the use of the best materials and fittings the market can afford; the best possible workmanship; a large disengaging surface for the steam to escape from the water; small cast iron pressure parts; ample heating surface to prevent injury to parts should boiler be forced above its rating.*

Examine these Points in the Improved Root Water-Tube Boiler.

Send for our Illustrated Catalogue.

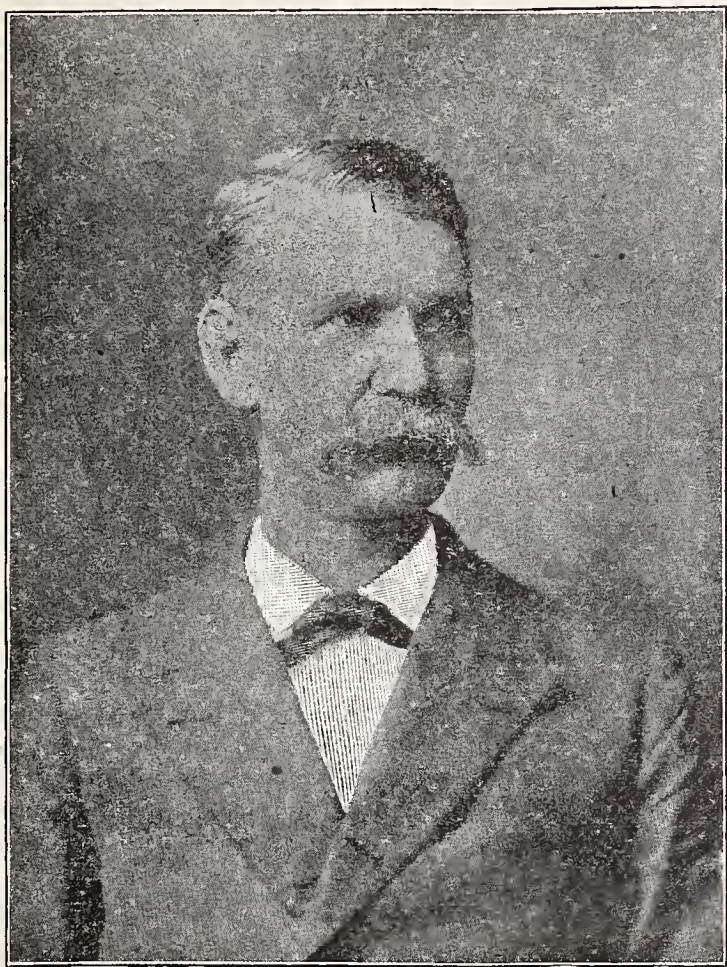
ABENDROTH & ROOT MFG. CO., 28 CLIFF ST.,
NEW YORK CITY.

The Electrical Age.

VOL. XXII—No. 10

NEW YORK, SEPTEMBER 3, 1898

WHOLE No. 590



Albion E. Lang, President A. S. R. A., 1897-98.



Robert McCulloch, President A. S. R. A., 1896-97.

ANNUAL CONVENTION OF THE AMERICAN STREET-RAILWAY ASSOCIATION.

Boston will be full of street-railway men this week. The seventeenth regular annual meeting of the American Street-Railway Association will be held there during the 6th, 7th, 8th and 9th of September. The city of Boston is a well chosen spot for a convention of this kind, as it inherits traditions that make it unique among American cities and to Americans and is also the heart of great electrical industries, particularly electric street railways.

The great Boston tunnel has been mentioned repeatedly in the electro-technical journals, and the great power-houses have received constant mention. It is therefore likely that the Boston convention will be remembered by delegates as a circumstance of great interest possessing features of attraction that will always make it a pleasant memory.

It may be interesting to our readers and to the present members of the association to know that the first meeting of the American Street Railway Association was held at Young's Hotel, December 12, 1882, more than fifteen years ago. The birthplace of an individual or an organization is always interesting in after years, when times and events have favored the growth of either.

The association was originally founded by H. H. Littell, Walter A. Jones, Thomas Lowry, Henry M. Watson and J. E. Rugg. Mr. D. F. Longstreet is credited with the idea or at least the suggestion that led to the organization of this association. A letter was prepared and sent to all the street-railway companies in the United States and Canada, the purpose of which was well stated. All traction companies were asked to support and assist in the formation of an association for the "promotion and advancement of knowledge, scientific and practical in all matters relating to the construction, equipment and management of street railways; the establishment and

maintenance of a spirit of fraternity among members of the association by social intercourse and friendly exchange of information and ideas to the end that the best service may be obtained at the least possible cost." Thus it was that life was first given through the earnest efforts of these men to this new and now powerful organization.

The last convention took place at Niagara Falls, and before that meetings have occurred in all the large cities of the Union, as far north as Montreal, as far south as Atlanta. Since the first meetings have taken place the face of this country in municipal centres has been transformed. The horse-car has almost disappeared; the dream of Stephenson, the great car-builder, has been realized, and in place of the curious and antiquated vehicles of not so long ago, we find well-equipped cars driven by electricity and provided with every convenience that safety, common sense and a spirit of æstheticism can recommend. The labors of early electricians have become historic. Menlo Park, with its little strip of track, should be well remembered by those that now live on the fruit of this great industry. Since horse-car traction has given way to the inroads of electricity a study of tracks and motors, cars, stations and all pertaining thereto has become imperative, and as the association originally met to discuss the ways and means of saving horse-flesh and keeping their roads in good order, so now do they meet to consider the best means of saving current, and again, as of old, to discover remedies for faulty tracks and inefficient power-houses.

A list of papers to be read at the Boston convention by experienced electrical engineers and business men is as follows:

1. "Maintenance and Equipment of Electric Cars for



T. C. Pennington, Sec'y 1896-7.



H. M. Watson.



G. B. Kerper.



H. M. Littell.



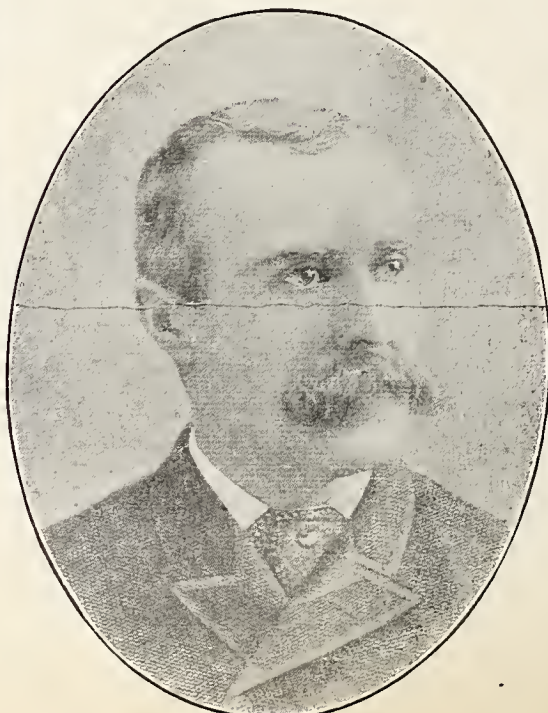
H. C. Payne.



Joel Hart.



C. B. Holmes.

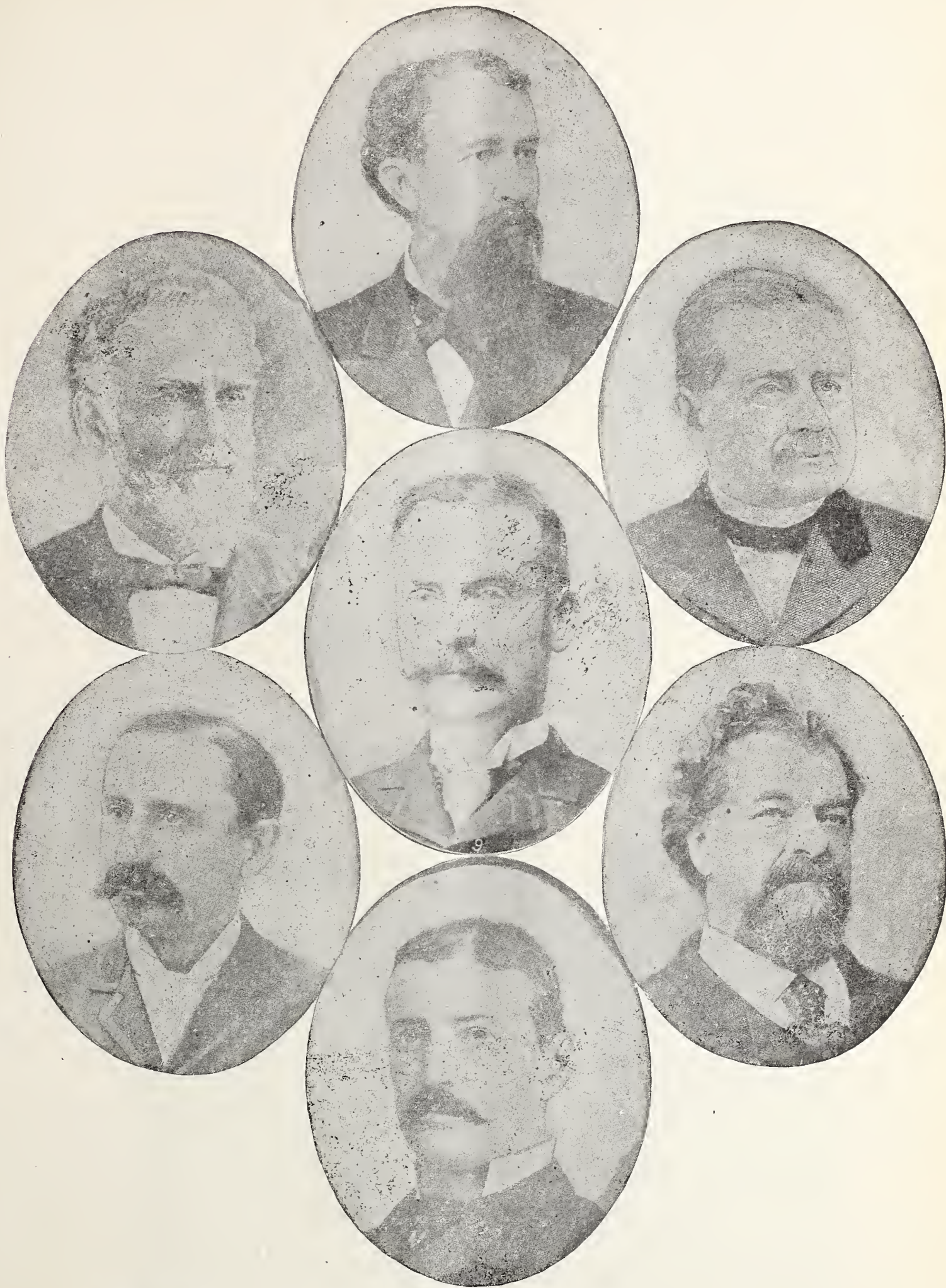


D. F. Longstre t.

PAST PRESIDENTS,
A. S. R. A.

Railways," by M. S. Hopkins, Electrician Columbus Street Railway Company, Columbus, Ohio.

3. "The Carrying of United States Mail Matter on Street Railways," by W. S. Dimmock, General Superin-



W. H. Hazzard,
1883-1884.

H. H. Littell,
1882-1883.

Thomas Lowry,
1889-1890.
John G. Holmes,
1891-1892.
J. S. Walsh,
1885-1886.

T. W. Ackley,
1886-1887.

C. A. Richards,
1884-1885.

2. "To What Extent Should Railway Companies Engage in the Amusement Business?" by W. H. Holmes, General Manager Metropolitan Street Railway Company, Kansas City, Mo.

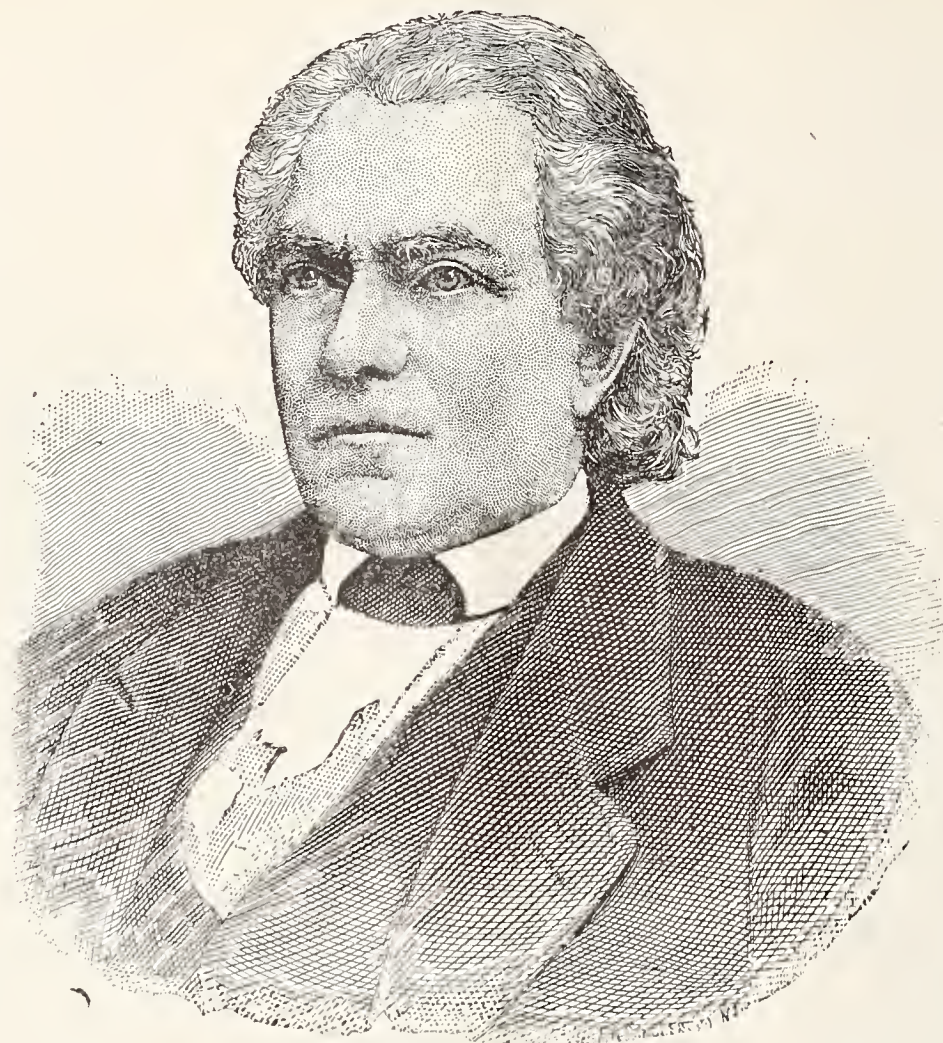
tendent Omaha & Council Bluffs Railway and Bridge Company, Council Bluffs, Ia.

4. "The Comparative Earnings and Economy of Operation Between Single and Double Truck Cars for City

Use," by Richard McCulloch, Electrical Engineer, Cass Avenue and Citizens' Railway Companies, St. Louis, Mo.

5. "Inspection and Testing of Motors and Car Equipment by Street Railway Companies," by Frederick B.

Massachusetts Charitable Mechanics' Association Hall. This hall is situated in the immediate vicinity of the largest hotels of Boston and is quite near the centre leading to all points of interest.

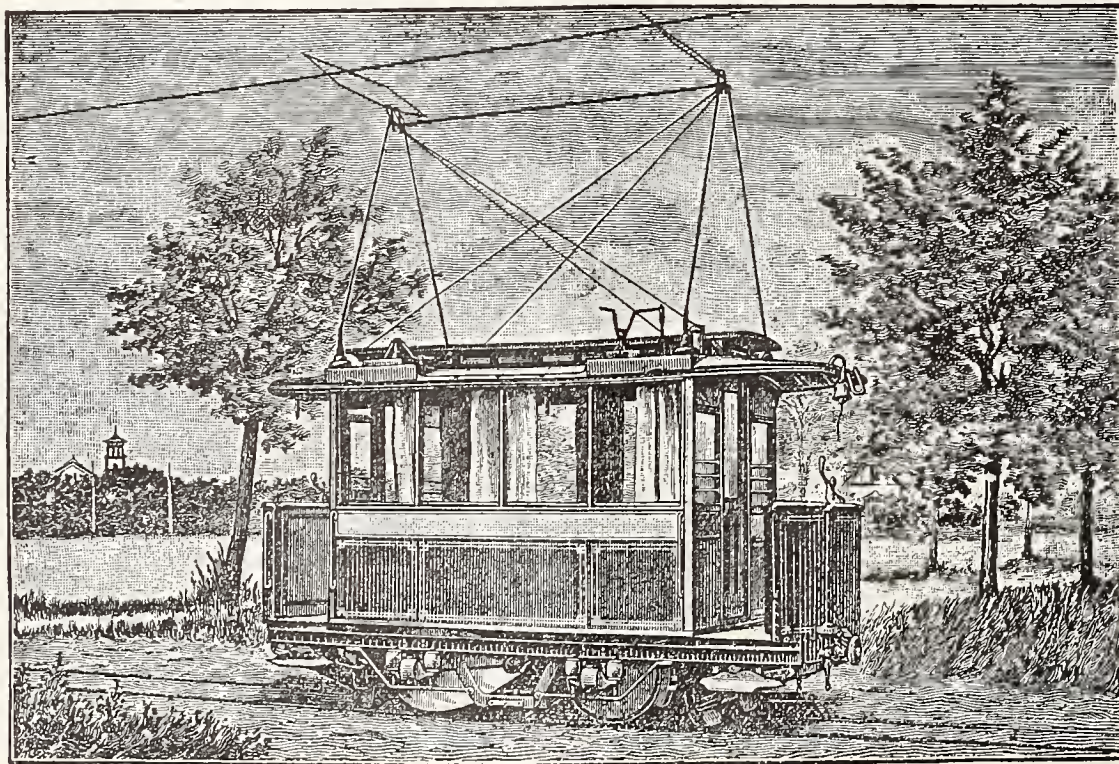


John Stephenson.

Perkins, Electrical Engineer Toledo Traction Company, Toledo, O.

6. "Cost of Electric Power for Street Railways at Switchboard; both Steam and Water," by R. W. Conant,

The past executives of the American Street Railway Association, through their individual efforts, have added so largely to the success the Association now enjoys that we thought our readers would be pleased to see them



The Trolley Car Before the Days of Its Popularity.

Electrical Engineer Boston Elevated Railway Company, Boston, Mass."

Some of our very largest manufacturers of cars, locomotives, motors, trucks, wheels, etc., will exhibit in the hall at which the convention will be held, namely, the

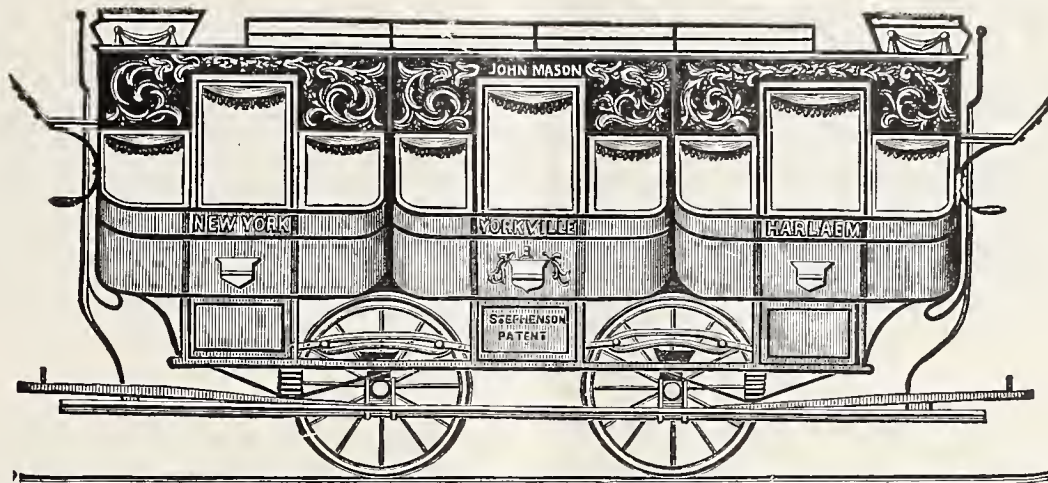
face to face. The gentleman still in office is Mr. Albion E. Lang, president of the Toledo Consolidated Electric Company, of Toledo, O., a man of considerable executive ability.

The convention will be opened up by many prominent

characters of Boston and will extend from Tuesday until Friday of next week. At the last meeting the following officers were elected: Albion E. Lang, of Toledo, O., president; first vice-president, W. Caryl Ely, of Niagara Falls, N. Y.; second vice-president, J. A. Riggs, of Reading, Pa.; third vice-president, E. G. Connett, of Nashville, Tenn.; secretary and treasurer, T. C. Penington, of Chicago. The executive committee is composed of the following gentlemen: Robert McCulloch, of St. Louis; C. D. Weyman, of New Orleans; H. C. Moore,

Profits of Railways.

The report of the Interstate Commerce Commission shows that last year the railways of the United States carried over 13,000,000,000 passengers 1 mile. They also carried 95,000,000,000 tons of freight 1 mile. The total amount paid in dividends on stock was \$87,603,371—call it \$88,000,000. Of the total earnings of the railways about 70 per cent. came from the freight service and 30 per cent. from passenger service. Let us assume, then, that of the \$88,000,000 paid in dividends, 70 per



One of the Early Types of Stephenson's Cars.

Trenton, N. J.; John Roach, Chicago; R. S. Goff, Fall River, Mass.

The customary nominations and elections will be in order at the convention in accordance with the prescribed rules.

RAILWAY NOTES.

The Safety of Railway Travel.

Last year on American railways one passenger was killed in accidents out of every 2,827,474 passengers carried. That is to say that you can take a train 2,827,474 times before, on the law of averages, your turn comes to be killed. You will have to travel 72,093,963 miles on the cars before that turn comes, and 4,541,945 miles before you are injured. If you travel 20 miles every day for 300 days in the year, you can keep on at it for 758 years before your turn comes to be hurt. If there had been railways when our Saviour was born and you had begun to travel on the first day of the year A. D. 1, and had travelled 100 miles in every day of every month of every year since then, you would still have (in this year 1898) nearly 3,000,000 miles yet to travel before your turn came to be killed.

Taxes Paid by Railways.

The preliminary report of the Interstate Commerce Commission for 1897 shows that last year the railways of the country paid \$40,979,933 in taxes. All companies had not reported, but compared with the preceding year the report shows that on about 2,000 miles of road less in 1897 than in 1896 the railways paid about \$3,000,000 more of taxes. The total dividends paid during the year were \$57,290,579. Out of every 97 cents earned by the railways above expenses, therefore, 57 cents was profit and 40 cents went in taxes. In the central southwestern states (Kansas, Missouri, Arkansas, Colorado, Oklahoma and Indian Territory) the taxes exceeded the dividends by nearly \$3,000,000. In Texas taxes exceeded dividends by over one million. In New England and the northeastern states dividends largely exceeded the taxes. The report shows that in the densely populated states the railways could pay more taxes than they do, but that in the less populous states of the middle and west the taxes are already in excess of the profits from the business.

cent., or \$61,600,000, was profit on freight service and \$26,400,000 was profit on passenger service. Let us drop fractions and call it \$62,000,000 from freight and \$26,000,000 from passengers. By dividing the passenger profit into the number of passengers carried (13,000,000,000) we find that the railways had to carry a passenger 500 miles in order to earn one dollar of profit—or 5 miles to earn one cent. Their average profit, therefore, was less than two-tenths of one cent for carrying a passenger (and his baggage) 1 mile.

By dividing the freight profit into the freight mileage (95,000,000,000) we find that the railways had to carry one ton of freight 1,530 miles in order to earn one dollar, or over 15 miles to earn one cent. The average profit, therefore, was less than one-fifteenth of a cent for carrying a ton of freight (besides loading and unloading it) 1 mile.

JOHN HOPKINSON'S DEATH IN SWITZERLAND.

A cable from London announces the accidental death in Switzerland of John Hopkinson, "the celebrated English electrical engineer," and that of his son and two daughters. From the meagre information at hand, we learn that the party started out on August 27 from Arolla, in the Canton of Valais, to ascend the Dent Vesivi without a guide. As they did not return at night, a searching party was organized, with the result that all four bodies were found at the foot of a precipice over which they had fallen.

Montreal, Que.—An important contract has been made between the Dominion Cotton Co. and the Royal Electric Co. The former are to install electricity in their works as motive power. The contract calls for 1500 horse power from the Chambly works, with option of increasing it to 3000; the contract is to run twenty years.

Kingston, Ont.—The Electrical Construction Co. of London, Ont., are in need of increased accommodation, and an effort is being made to have the company install its works in this city.

Listowel, Ont.—The by-law to raise \$19,500 for water works and electric light purposes was defeated by the ratepayers.

MECHANICVILLE.

Introduction.

The development of the power of St. Anthony's Falls on the Mississippi at Minneapolis, Minn., is followed closely by the utilization of the power of the upper waters of the Hudson River at Mechanicville, N. Y.,

the present point of development have been to some extent employed by factories using low-head turbines directly driving their machinery, but not until the undertaking just concluded was decided upon had any very



Power House from Up-stream Side.

where an undertaking of no less magnitude has within the past few days been completed. Five to seven thousand horse power is available at the power house, and the

serious effort been made to take advantage of the great amount of power which has run to waste for ages down the stream of the main waterway of the Empire State.



A Main Wheel Chamber, Mechanicville, N. Y.



The Main Dam and Waste Gates.

use of high tension current permits of its distribution over a wide territory.

As in the Mississippi, the waters of the Hudson above

Early in 1897 the attention of Mr. R. N. King, president of the Stillwell-Bierce & Smith-Vaile Co., of Dayton, O., was drawn to this water power. His long experi-

The Electrical Age.

ESTABLISHED 1883.

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ENGINEERS FOR FIRE PROTECTION.

One of the demands of the municipality is that all new buildings and old shall be protected against fire and that any installations contained therein shall be free from any immediate possibility of fire. Modern buildings of large size are equipped with steam and electric light machinery, fire from which could arise at any moment unless precautions are taken of a most definite character to prevent the same. In consequence of this a department of engineering new in its way has been suggested by Mr. H. L. Phillips, which will consider ways and means of protecting property from fire in any form due to the arrangement of machinery within. This is a most interesting field of investigation and worthy of serious consideration by not only professional men or engineers, but the public at large, to whom the loss by fire annually exceeds one hundred millions of dollars.

The electrician should feel particularly impressed with the necessity of putting in an installation safe in every respect and amply protected with the proper fuses and adjustment of wires from fire risk. Whenever there is a mystery attached to a fire, allusion is made to the electric light wires in the building; but in answer to this we may say that under no circumstances is a building under less risk from fire than when wired by a conscientious contractor in a manner that meets with all the requirements of the city fire underwriters.

Attention need not be especially directed towards the purely electrical portion of the work, but to the steam-pipe system, boiler, position of coal supply, etc. The general arrangement of these things counts for a great deal in the eyes of insurance companies when application for insurance is made by a large concern. A casual examination of the interior of a building does not always disclose the immediate chances of fire present there. Such an examination should be backed by considerable experience and an extensive knowledge of the effects of too close a

juxtaposition to materials normally safe, but which under the influence of a constant heat, vibration, etc., might change in character and give rise to a conflagration.

As the hygienic demands of city residents became more pronounced and it was necessary to discover and prevent the mischief arising from poor sanitary accommodations, a new field of engineering developed and received recognition in many of the largest universities under the name of "Sanitary Engineering." In the same sense the necessity for a department of fire-protection engineering in some of the universities is obvious. A degree of this kind would confer upon its holder an immense amount of responsibility in the inspection of buildings and demand from him an intimate knowledge of many of the details of construction in electrical and mechanical engineering.

Mr. Phillips makes mention of the fact that "the electrical engineer must give consideration to the element of fire in arranging the lighting or power apparatus, and special rules have already been formulated regarding the installation of such an equipment. All matters of this sort, strictly speaking, come within the scope of fire-protection engineering and should be taken up in connection with it. And here we have another field for men trained in the new science."

THE ORGANIC ELECTRIC BATTERY.

Some of the reasons why Nature produces abnormal organic types are so completely hidden that we are forced to resign ourselves to the fact and frame a hypothesis as to their primal cause. A large variety of fish possess an electric organ composed of a series of cells enabling them to affect a discharge of nearly eight hundred volts pressure. The origin of this organ, the history of its development and the means by which the fish is enabled to accumulate electrical energy, are at present beyond our powers of exact comprehension. The batteries possessed by these fishes are apparently unisolated from the body of the fish itself, and more curious still is the fact that the fish is exposed to the shock of each discharge as well as the victim receiving it. Mention is made by Faraday of the extent of this discharge of an electric fish, the gymnotus, by his comparing it to the discharge of fifteen Leyden jars connected in series. The fact that the fish itself is neither stunned nor shocked by its own discharge, has been explained by considering its immunity due to inherited familiarity with the same for countless ages. This species has used functions as described, and in the course of many centuries become insensible to the influence of high potential currents.

Mr. W. W. Knight, in an article on electric fishes, in the "Yale Scientific Monthly," mentions an experiment in which a spark coil was applied to an electric fish. The shock of the coil barely affected it, whereas it killed pike and chub immediately.

It is very likely that in some mysterious way a transformation of nerve energy occurs in the fish whereby it is able to give rise to electric discharges, or the nutrition of the cells of the battery from which discharges proceed calls heavily upon the strength of the fish in the same manner that continued thought affects the strength of a brain-worker. As these discharges of electricity take place at the will of the fish, there is certainly some relation existing between the battery and the principal nerve ganglion. It would be interesting to discover whether electricity is produced from a foreign secretion differing from those usually discovered in marine animals, or whether each tremendous discharge is merely due to a transformation of nervous force into electrical energy.

Raleigh, N. C.—The Raleigh Electric Co. has ordered new machinery to be placed in its electric power plant.

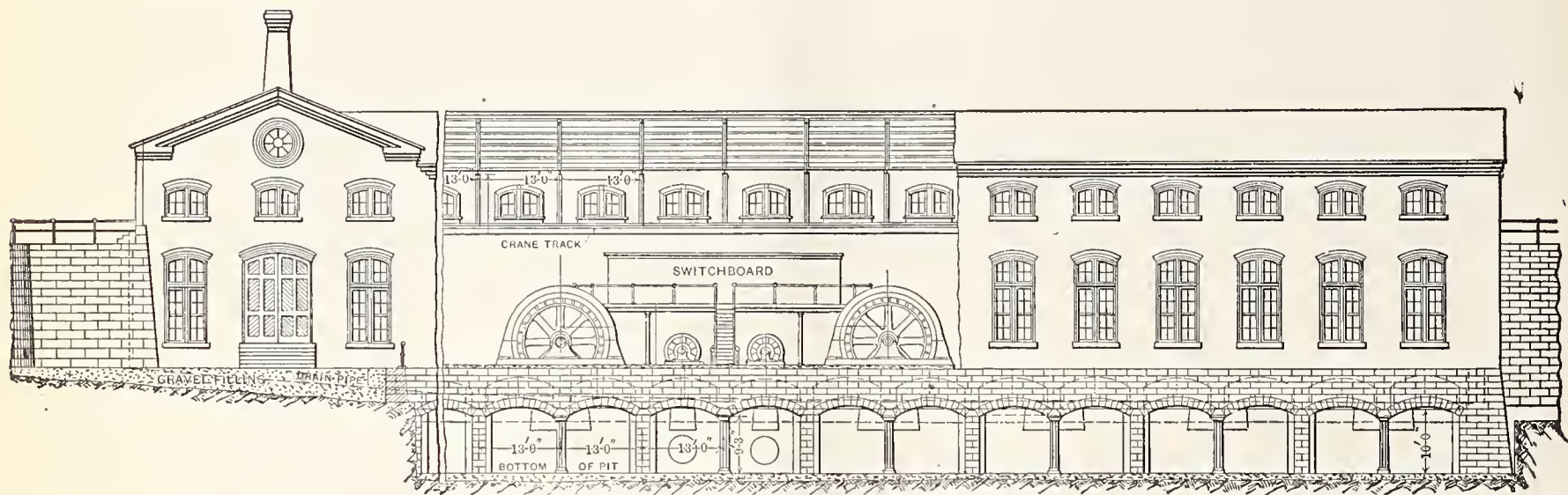
ence with water powers and their development led him speedily to recognize the possibilities which here lay ready to hand. The site is only two miles from Mechanicville, eleven miles from Troy, and eighteen miles from Albany, in each of which towns large quantities of power would without doubt find a market. But, most important of all, it lay only seventeen miles from Schenectady, where, covering not less than 130 acres of ground, the largest electrical works in the world are operated from an extensive steam plant with which the electrical power from the Mechanicville cataract could readily compete.

After consultation with the chief engineers of the Gen-

of both hydraulic and electrical engineers is a power transmission plant in every respect strictly representative of the most modern hydraulic and electrical practice.

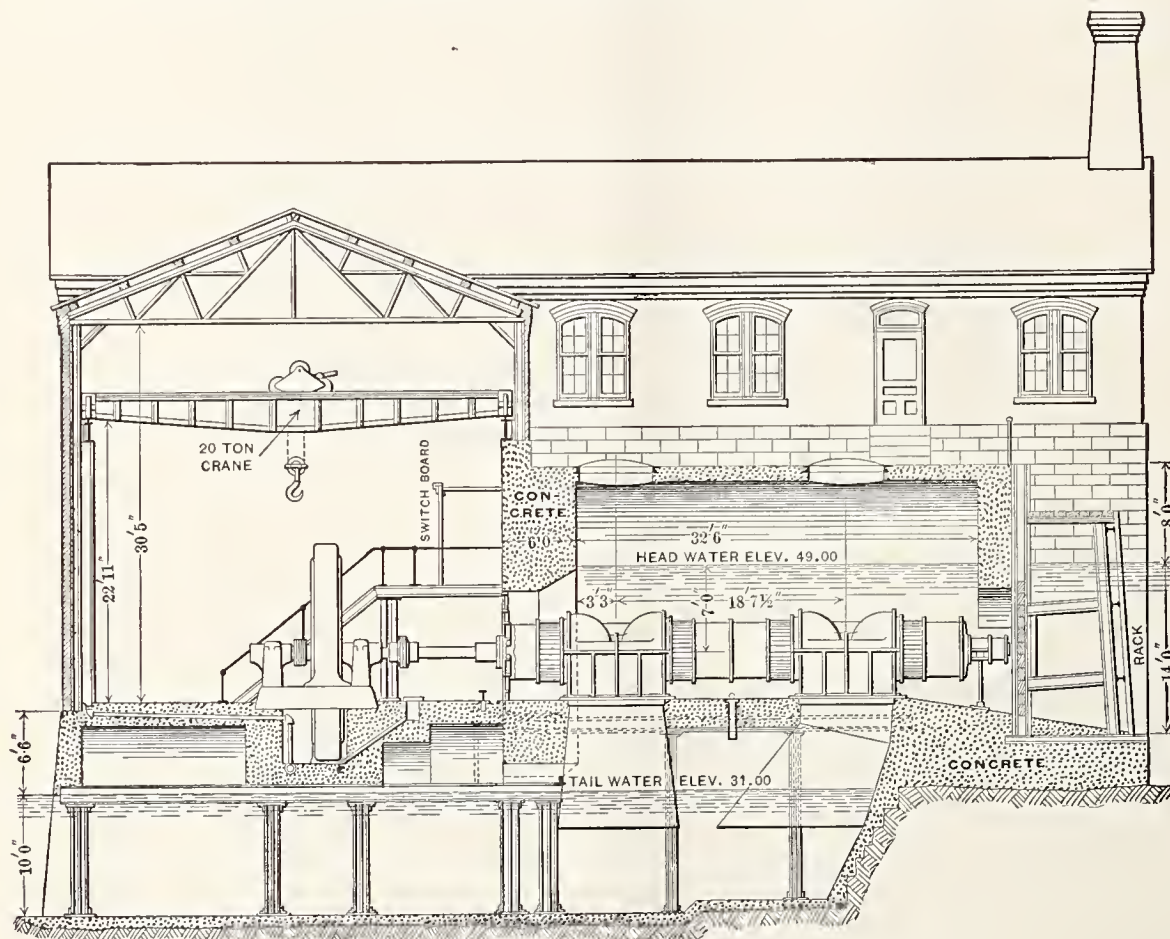
General Location.

At the point chosen for the hydraulic development the physical positions make the location an ideal place for a dam and power house. The banks and bottom of the river are of rock, as is Bluff Island, which divides the Hudson into two channels, and here during the greater part of the year is water sufficient to produce from 7,000 to 10,000 H. P.



SIDE ELEVATION LOOKING UP STREAM.

Side Elevation of Power House, Mechanicville, N. Y., Looking Up-stream.



Section Through Wheel Chambers, Mechanicville, N. Y.

eral Electric Company, in which the necessary assurances were given, Mr. King formed the Hudson River Power Transmission Co.

The hydraulic engineering features of the development were carried out in their entirety by Mr. A. C. Rice, chief engineer of the Stillwell-Bierce & Smith-Vaile Co., and it may be said that in the complete work as it stands today little or no departure from the plans laid down by Mr. Rice has been made. As the General Electric Co. was to purchase the largest amount of power, its advice as to the electrical equipment was naturally closely followed. The result brought about by the harmonious co-operation

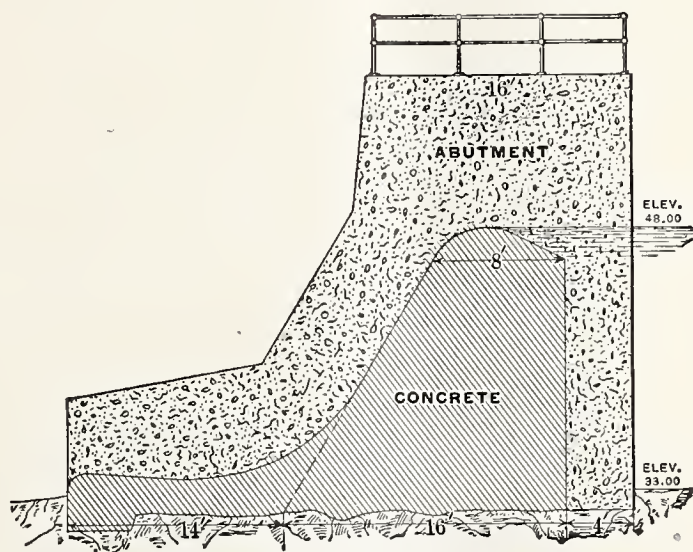
The island is about one-third of the distance across the river from the western bank, the combined width of the two channels being about 1,200 feet. The western channel is used for the head and tail races.

In order to make the excavations for the power house and the main dams, heavy coffer dams were built across both streams. The work would have been completed well within the time at first specified had not an extraordinary freshet swept away part of the coffer dam, necessitating long delay before work could be resumed. The rock and shale resulting from the excavations proved unsuitable for incorporation into the concrete for the dam and foun-

dations, and the broken rock used was brought over a special track from the neighborhood of Schenectady.

Dams.

The power house starts from and extends out into the river about 215 feet, and is connected with Bluff Island by a concrete dam, 26 feet above the bed of the river, 10 feet wide on top and 18 feet wide at the base. The up-stream face is vertical and the down-stream face sloping. The top of this dam is at an elevation that the water will never reach; thus, no provision is made to take care of falling water on the down-stream side, but the dam is provided with four arched waste gates, 4 feet wide and 6 feet 9 inches high, operated in the same manner as those in the main dam.



Section Through Main Dam.

The main dam is on the eastern side of the island. It is built of concrete, as is indeed the entire construction, with the exception of the upper walls of the power house. The up-stream face is vertical; the down-stream face is curved and provided with a horizontal apron 14 feet wide, which throws the falling water off horizontally, and thus effectually prevents wash or scour of the top of the dam. The dam is 16 feet high above the river bed, 8 feet thick immediately below the crest, 16 feet thick through the base, and 30 feet thick through base and apron. The dam is set between massive abutments anchored to the rock sides of the river bank and island. The eastern abutment is 20 feet long, 26 feet high above the river bottom, 16 feet thick at the top and 34 feet wide at the base. The western abutment is 100 feet long, the other dimensions being similar to those of the eastern abutment. The length of the spillway between abutments is 800 feet. In the western abutment are twelve arched waste gates of ample proportions. Each gate is 4 feet wide and 6 feet high, and is opened and closed by a heavy iron hoist operated by rack and pinion. The eastern dam is practically a solid rock wall capable of safely resisting any flood. It was severely tested in the spring of 1898, when a flood of extraordinary proportion came against it, yet, notwithstanding the fact that the dam was green, the flood in no manner injured it. To prevent any floating rubbish, ice or logs reaching the rocks or choking the waste gates, a floating wooden boom stretches from the western end of the spillway diagonally for a distance of 400 feet to the edge of the normal river bank, and then for a distance of 1,000 feet to the main embankment of the Mechanicville highway. It is anchored by a line of stone-filled cribs.

Between the west end of the power house and the Mechanicville highway a broad roadway has been built of earth and slate rock.

To avoid any possibility of water finding its way through the embankment in case of very high water a concrete core was put in the centre, starting at the solid rock and finishing two feet below the surface of the road. The embankment forming the roadway is 40 feet wide on the top, 124 feet at the base, and 18 feet high at the deepest point.

The Power House.

The power house lies between the west bank and the short concrete dam, nearly filling the space between the island and the west bank of the river. It is practically a continuation of the dam, and, like the main dam, is of concrete, with the exception of the upper walls. Its construction is of the most substantial character; the foundations are carried down to the bedrock, and the house is carried on heavy steel box-web girders resting upon steel I-beam columns. The latter are imbedded in concrete walls carrying arches, which form the floor of the generator room and the floor on which the wheel flumes rest. The walls form a separate and distinct tail race 22 feet wide for each set of turbines, from which the water may be shut out at will.

The house is divided into two parts by a thick head wall. The up-stream part contains wheel chambers for seven 1,000 H. P. wheels, of which five only are at present occupied. The down-stream portion contains the wheel governors and the electrical apparatus. The length of the power house proper is 257 feet 6 inches; the width of the dynamo room between head wall and south wall 34 feet, and the width of the wheel chamber portion 32 feet 6 inches. The total width of the power house is 66 feet 6 inches. At the western end an L extension runs up-stream, 87 feet 5 inches long and 44 feet 10 inches wide. This portion of the power house is of brick. A retaining wall runs down-stream from the power house along the western bank a distance of 50 feet. The western stream running between the bank and the island forms the forebay, 300 feet long. The main tail race is 205 feet wide and joins the main stream 750 feet below the power house.

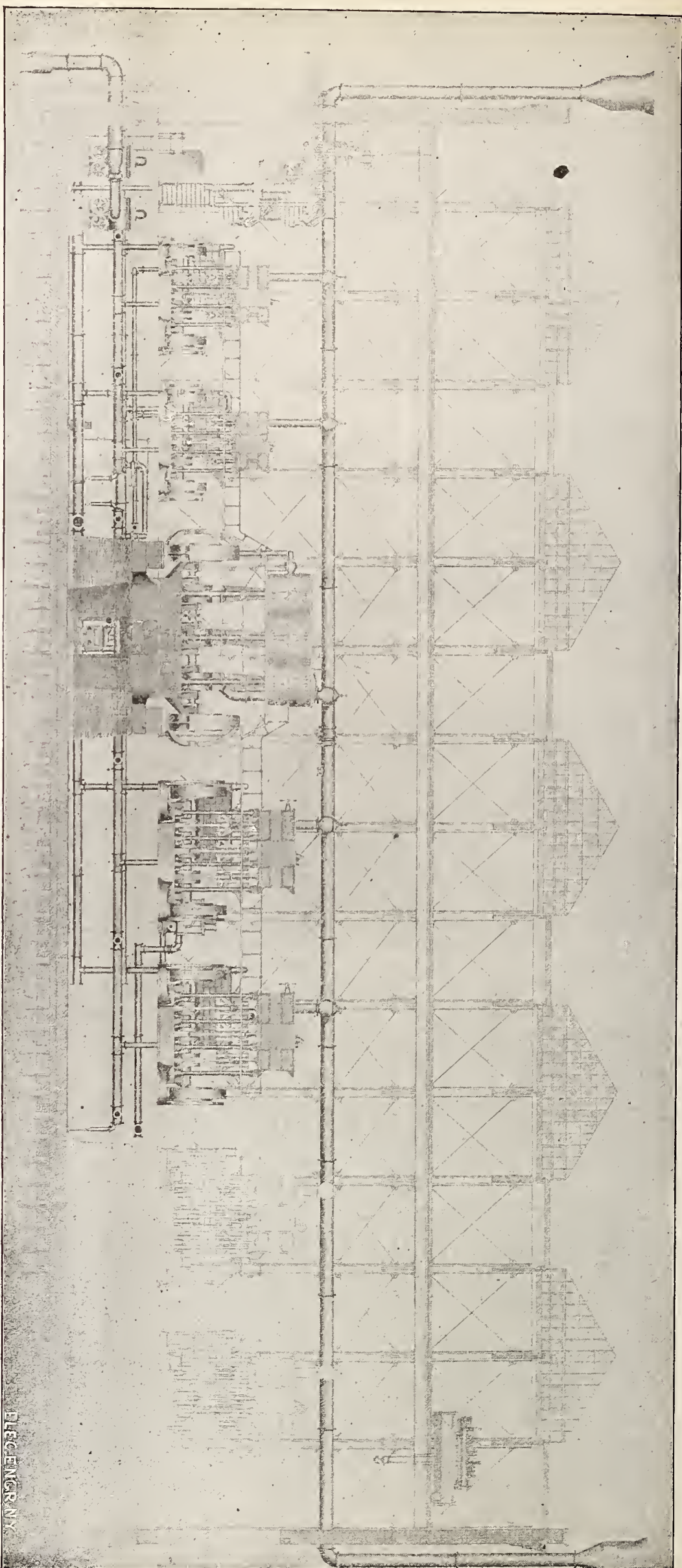
Arched chambers are provided for seven main wheels and two exciter wheels. Each main chamber is 32 feet 6 inches long, 22 feet wide, and 17 feet 5 inches high, and is provided with two 6-foot manholes. Each exciter wheel chamber is 32 feet 6 inches long, 17 feet 5 inches high, and 10 feet wide. The head wall of the chambers is 6 feet thick, the wall on the up-stream and both sides 3 feet thick. In the head wall of each main chamber is set a heavy cast iron cover through which the turbine shaft passes in a water-tight packing box, carrying the ring oil bearing for the shaft. The saving in space effected by the new arrangement of housing and coupling together of the turbines, patented by the Stillwell-Bierce & Smith-Vaile Co., has tended to diminish considerably the size of the power house.

A 20-ton crane from the works of Pawling & Harnishfeger, Milwaukee, runs the entire length of the dynamo room.

In front of the wheel chambers and running the entire length of the power house is a trash rack of steel bars supported on a frame-work of steel channel and I-beams. This rack effectually prevents access to the wheels of any rubbish or floating material that may escape the boom.

Main Wheels.

The main wheel plant consists of ten pairs of 42-inch



(Chicago Edison Company.)
A Modern and Model Power Plant.

horizontal Victor turbines of the latest type, built by the Stillwell-Bierce & Smith-Vaile Co., of Dayton, O. Each main turbine consists of two pairs of wheels, which at the normal speed of 114 revolutions is rated at 250 H. P. The total power of each set of turbines is, therefore, 1,000 H. P. Five units are now in position; the two additional turbines will be installed shortly. The head under which the water wheels are operated is 18 feet.

(To be continued.)

Ashcroft, B. C.—The Ashcroft Water, Light and Power Co. will erect a power house on the Bonaparte river, about three miles from here, and install an electric light and power plant.

REPAIRS OF ARMATURE, COMMUTATOR AND FIELD.

LESSON LEAVES

FOR

THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

(Continued on page 124.)

A burnt-out field indicates itself by a peculiar aroma of scorching cotton and shellac. If this occurs to one of the inner layers it will not be perceptible, but a heavy ground will result, and the smell of burning insulation will be an additional proof. If the field is reversed, the

proper connections can be very easily made, and if it heats to any unusual extent without actually burning, the coil has been poorly designed; its radiating surface is insufficient, and one of the best remedies is to interpose a resistance in its circuit so as to decrease the current flowing through it, and speed the armature up a little higher by the use of a smaller pulley, to keep the voltage the same as before. If the coil is merely grounded, and any anticipation of danger is felt by the engineer, the ground may be discovered between the terminals of the coil and the framework of the machine. In a new machine it may be likewise due to moist shellac; or if the coil is wound upon a metal sleeve, it probably exists in the innermost layer, and had better be left alone. It is always best for the engineer to test for his fields by holding some iron object firmly in his fingers and bringing it to either pole or poles of the machine, or the polarity can be directly ascertained by means of a compass.

Model Plants.—The expression "model plant" is self-explanatory. To the engineer, a perfectly equipped system of electric light appeals as strongly to his sense of beauty and idea of completeness as a work of art, of sculpture or of rare design. A harmony can exist in the engine room or station that suggests at once the touch of a skilled hand and comprehensive view of an experienced mind.

To construct a model plant is not only to set up an engine and dynamo on a substantial foundation, but to have in addition to these the latest and best accessories for its smooth running, its ready supervision and economical handling. A model plant should never be wasteful, as the very object of having an elaborate outfit is to prevent or reduce the expense of operation. A model plant should not be a source of constant bother; it should not necessarily include self-acting devices, which are too impractical and, therefore, unreliable for continued use. It has been discovered, in the majority of cases, that the beauty of a plant begins at the boilers and extends from there to the engine room. The essential parts of a model plant are—

- An efficient boiler,
- An automatic engine,
- A self-regulating dynamo.

An efficient boiler can only be considered as such when its power of making steam is great in comparison with the weight of coal consumed. In all boilers a considerable quantity of unburned fuel escapes as smoke. Heat is wasted from the furnace, boiler shell, steam pipes, etc.; the very smoke that escapes is due to lost heat. An efficient boiler, as ordinarily understood, would be one a little better than the others. But supposing this slight gain in efficiency adds a greater item of expense to the price of the boiler or necessitates such extra labor that the additional efficiency becomes a plague and a nuisance, there is evidently no gain in using a boiler of this kind. Here is a statement which will give an idea of the amount of power wasted between the furnace and the engine: "It has been satisfactorily demonstrated that in the very best engine, even if it were theoretically perfect, and working at ordinary ranges of temperature, only somewhere about one-fourth of the heat which is actually employed is converted into work; that is to say, three-fourths of the coals, or three-fourths of the heat employed, are absolutely wasted under the most favorable circumstances." Boilers are on the market today which are far superior to any previously introduced, which may use culm, the cheapest product of the mine, and in cheapness and serviceability highly commendable. The weight of coal consumed for a given quantity of steam can be otherwise put as the weight of coal consumed for a given amount of energy—so many pounds per horse-power hour. About two and a half to three pounds per H.-P. hour is the best point reached in practice with triple expansion engines. The weight of coal may increase as high as

five or six pounds per H.-P. hour in poor engine equipments.

An automatic engine is one which can regulate with changes of load; that is to say, keep its speed constant. This is very necessary with a dynamo attached, as a reduction of speed with an increase, or a raising of speed with a decrease of load would mean either a poor light from the lamps or an exceedingly bright light from them; the poor light fading with each new circuit thrown in, the bright light becoming dangerously stronger, to the detriment of its filament with a higher speed, due to the lesser load. A model plant must therefore have an engine of uniform speed, and as unchangeably so as possible. It must have an efficient boiler, which is clean and provided with the proper attachments for its protection, and the necessary heating surface, so as to burn its coal economically and well.

A self-regulating dynamo can only be called by that name if it fulfils the functions expected of it—if it sustains one pressure throughout all change in the lights; if it is automatic; in other words, if it regulates. The best machines of today are of the multipolar type. They are not model machines, and cannot be considered a desirable addition to a model plant unless they regulate; do not heat, either in field armature, bearings or commutator, and do not spark at the brushes. A dynamo from a mechanical standpoint is a simple piece of mechanism. It is not difficult to attain comparative perfection in this respect, and such perfection is essential. The electrical designer must provide the proper surfaces and cross sections for the radiation of heat. The current squared multiplied by the resistance in fields and armature respectively give the value of this in watts. The good design of a dynamo greatly depends upon the ability of its armature to radiate heat. Sparklessness is a feature which above all things should be absent.

A model plant can but begin to be such when a boiler, engine and dynamo meet these purely practical demands herein outlined. A switchboard containing voltmeters and ammeters, automatic cut-outs and ground detectors; a system of switches which places every circuit of consequence under the engineer's control, complete so necessary an adjunct to a complete plant. It becomes a model plant when the room is lofty and well lighted; when the engine and dynamo are upon solid foundations; when vibration is entirely absent and only the low murmur due to the perfection of such mechanism reaches the experienced ear.

QUESTIONS FOR REVIEW.

- (1) Of what parts is the dynamo composed?
- (2) What are the causes of grounds?
- (3) How is a coil repaired?
- (4) What ailments may attack a commutator?
- (5) How is a burnt-out field discovered?
- (6) What are the essential parts of a model plant?
- (7) What is an efficient boiler?
- " " " automatic engine?
- " " " a self-regulating dynamo?

TRANSFORMER ECONOMY.*

By Professor Winder Elwell Goldsborough, Purdue University, Lafayette, Indiana.

A great deal has been said and written about the static transformer of alternating currents, and yet we are only just beginning to understand this much-discussed piece of apparatus. The manufacturers have made it and ex-

* Read before the National Electric Light Association at its twenty-first convention, held at Chicago, Illinois, June 7th, 8th and 9th, 1898.

perimented with it, the theorists have experimented with it and disputed over it, the underwriters have disputed over it and endured it, and the central station men have endured it and made use of it to the great good and comfort of the public. No other piece of apparatus in the field of electrical engineering has been lauded higher or been the subject of greater abuse, and to all it has served a purpose.

Today the transformer occupies a higher position than ever before, and it grows in importance as each new development in the field of applied electricity points out a new department of usefulness for it.

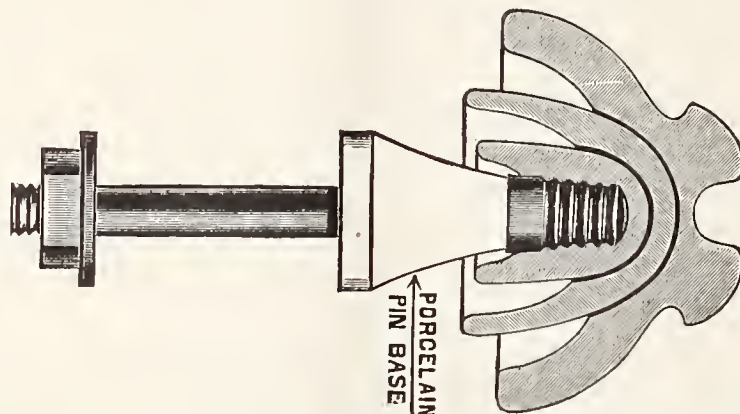
There has, however, been enough agitation lately on the part of manufacturers, in behalf of substituting new types of transformers for the old ones now in use, and of

sition. A fault is a fault at the present day, and is not often disregarded as "too small to be appreciable." The old saying that "if you take care of the pennies, the dollars will take care of themselves," applies just as well to electrical engineering as it does to other professions, and it is the "pennies" that I am about to deal with.

(To Be Continued.)

HIGH INSULATION LINE MATERIAL.

The triple petticoat porcelain insulator represented in this illustration is made from three shells of vitrified china fused together with glaze. A variety of sizes are made capable of withstanding potentials of from five thousand



Triple Petticoat, Porcelain Insulator—Made from Three Shells of Vitrified China, and Fused Together with Glaze.
Made in Several Sizes for Potentials 5,000 to 50,000 Volts.

relegating the small transformer to the scrap heap, to cause the central station men, who are responsible for the successful operation of alternating current generating plants, some unrest. The foundations of many of these plants were laid before the time of skilled designers of electrical machinery, and at a time when the factory motto was "cut and try." As the public demands increased, the plants developed and expanded before the practical men were amenable to "theories," and before the exact methods of the laboratory had become the daily practice of the constructing engineer. Managers see that engineers are still making mistakes, and that faulty design is still a factor in electrical development, and when they call to mind the enormous sums of money that have been spent in this country on ill-advised improvements it is not to be wondered at that they hesitate.

There is, however, a gradual change for the better in the number of the yearly contributions to the records of our electrical societies, and as these records are the expression of the best thoughts of the men who have made America famous as the land of electricity, they may be taken as signs of the times in our department of engineering activity.

We are constantly impressed with the fact that the refinements of exact scientific methods are being made the subject of every-day discussion, and that the more difficult problems of the technical side of the profession are being so well elucidated by our "practical theorists" that it is possible for all of us to enjoy a concrete appreciation of electrical science without an excessive expenditure of mental energy on the theoretical.

We are coming to a time when exact methods will be the universal rule and when the reputation of having a high "guessing factor" will no longer be a sufficient recommendation.

These influences are noticeable in the improved electrical intelligence of our workmen, as well as of our station engineers, and I find that it extends even to the general public. Indeed, a careful record of the number of times that I am asked "how does the little trolley wheel push the car along?" shows a yearly decrease of nearly 50 per cent.

So we see that matters adjudged to be of slight importance a few years ago are being allotted their normal po-

to fifty thousand volts. The manufacture of insulators for transmitting high pressures has developed into a high science. Many dozens of power plants installed in different parts of the Union transmit enormous pressures over lines in some cases twenty-five miles long. The safety and economy of the system depends almost entirely upon the insulators used. The strength and high insulating properties of the insulators sold by Frederick M. Locke, of Victor, N. Y., have secured for their manufacturer a national reputation. Mr. Locke has made practical tests of the insulator represented above, and it has been found capable of withstanding a pressure of one hundred thousand volts, which is certainly a sufficient guarantee of its efficiency in transmission work.

The complete absence of metals from the earths of which this insulator is made, the impossibility of the insulators deteriorating or cracking, has in addition to their capability of resisting gases and acids brought them into great demand by electrical engineers. Their high insulation resistance reduces leakage down to the lowest possible point, thereby securing for the purchaser the best article the market affords and a moral satisfaction in having obtained the best that money can buy.

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TURBINE WHEELS, for Heads of 3 to 220 feet.

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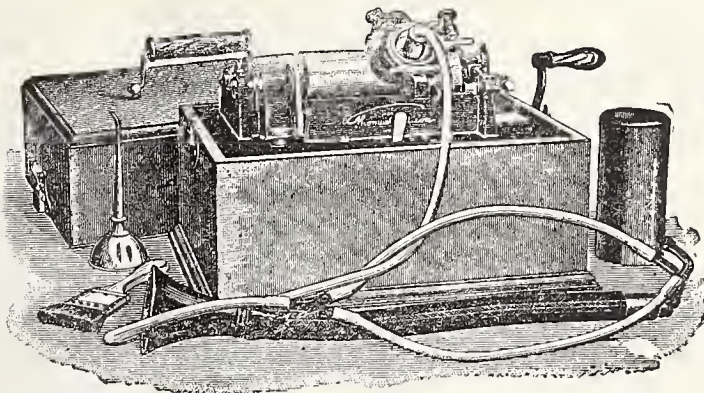
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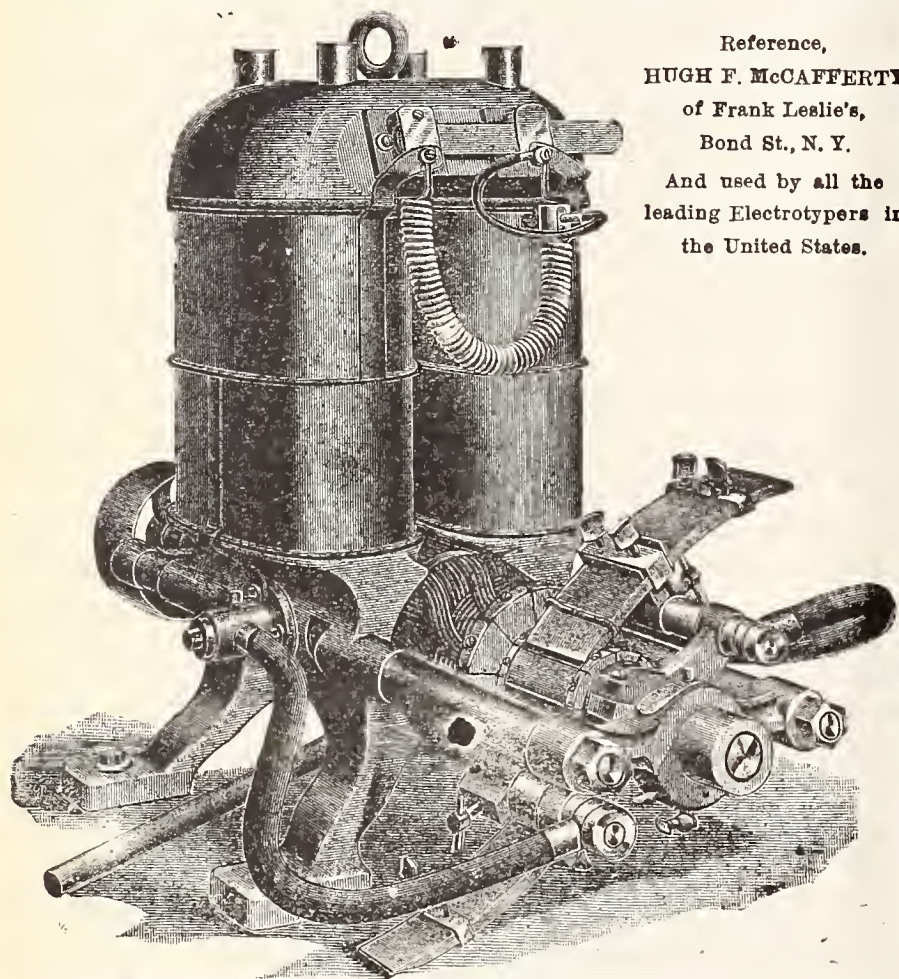
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And used by all the
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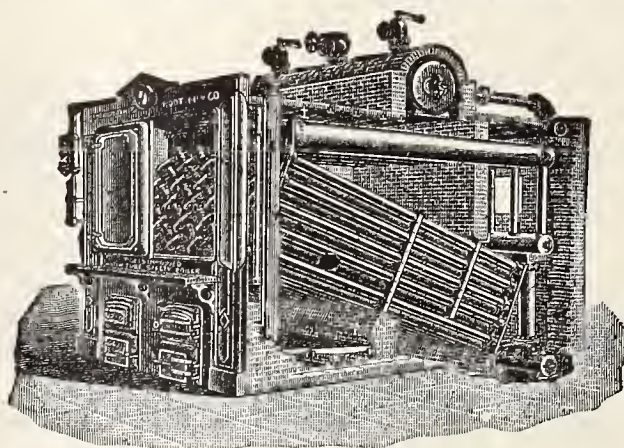
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ROOT IMPROVED WATER TUBE BOILER.



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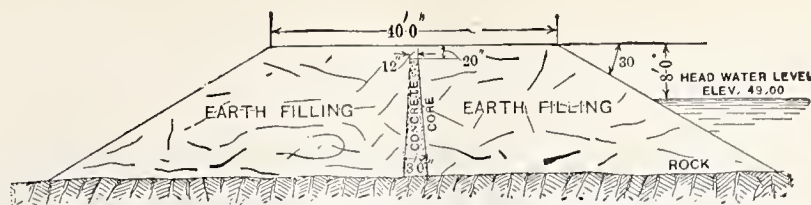
ABENDROTH & ROOT MFG. CO., 28 CLIFF ST.,
NEW YORK CITY.

The Electrical Age.

VOL. XXII—No. 11

NEW YORK, SEPTEMBER 10, 1898

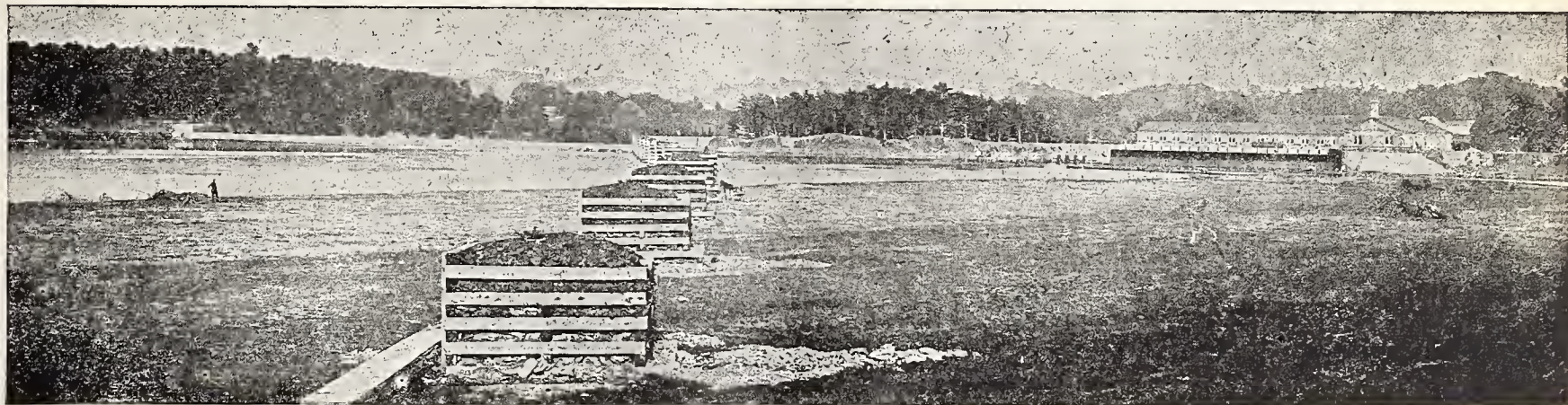
WHOLE No. 591



Section Through Earth Embankment.



The Power Before Development.



The Development of the Power.

MECHANICVILLE.

(Continued from page 136.)

Generators.

The dynamo room is a spacious chamber well lighted by windows on all sides. It is 255 ft. long and 34 ft. wide, 30 ft. 5 in. in the clear from floor to roof truss and 22 ft. from floor to crane. The ultimate generator capacity of the station is 7,000 H. P. in seven generators, each of 750 K. W. capacity. Five have been installed and are now running. They are unitooth, three-phase, forty-pole, 750 K. W., 114-revolution, alternating-current machines, having revolving fields and stationary armatures, and wound to deliver 36 amperes of current at a periodicity of 38 cycles and a pressure of 12,000 volts to the transmission lines. They are arranged for operation in parallel at constant voltage. By using the revolving-field type of generator and thus securing this pressure directly from the machine, the use of step-up transformers to raise the voltage for transmission purposes is avoided. As the current is to operate synchronous and induction motors, to operate lights and to be converted into direct current through rotary converters, a frequency of about 40 cycles was selected as most suitable for the different conditions required.

The alternators are similar in their main characteristics to those successfully used in the development of the power of the Lachine Rapids at Montreal. The armature frame or ring is of the box type, 15 ft. 4 in. in diameter and 36

in. wide. It is bolted to a base 18 ft. 2 in. long by 10 ft. wide, along which it may be moved parallel with the shaft, in order that the revolving-field spider and poles may be uncovered should occasion arise. The armature winding is protected on each side by iron shields. The pillow blocks are also bolted to the base and the bearings are of the spherical-seated self-oiling type used in all General Electric generators.

The field ring is bolted to the spokes of the spider. It carries 40 poles, each securely fastened by two bolts to the ring. The whole revolves on a shaft 15 in. in diameter, provided with a rigid coupling on the turbine side, bolted to a similar coupling on the turbine shaft. The dynamo shaft is extended for coupling to a vertical steam engine, in case of necessity.

The following reasons for selecting this type of alternator have been given by Mr. C. P. Steinmetz, of the General Electric Co.:

In addition to the advantage which the stationary-armature type has over the stationary-field type in allowing a high transmission voltage to be taken directly from the armatures, it allows of a fairly low saturation of the magnetic circuit, giving an almost straight saturation curve. This is preferable in power transmission, since a considerable increase in the voltage

may be obtained, if needed, to cover excessive drop in the lines due to heavy loads, and the voltage may be maintained even if the speed remains low.

Exciters.

The exciters are placed one on each side of the stairway leading to the switchboard gallery. They are

difficult currents of 21,000 volts. The switches are without handles. An eye is made in the end of each blade, into which a hook at the end of a stick may be inserted and the switch opened by the attendant from a safe distance. Further, to prevent any dangerous arcing from blade to blade, marble barriers 1 1/4 in. thick, 3 in. long, and 12 in. wide from the face of the board, are



A Shipment of Victor Turbines.

6-pole, 100 K. W., 125-volt standard General Electric machines, with ribbed field frame and iron-clad armatures.

Switchboard.

The switchboard, erected on a gallery on the north wall of the dynamo room, is built up of nine highly polished panels of blue Vermont marble, each panel 7 6 in. high, 3 ft. 0 in. wide, and 2 in. thick. Of these nine panels, five are used for the generators and two for the feeders; one is the total-output panel, and the last is for the control of the exciters. The generator panels occupy the left side of the board, and room on the gallery is left for two additional panels. The feeder panels are on the right side; the total-output

erected between each blade.

On the left-hand side of each generator panel subbase are two 100-amp., double-pole, double-throw, carbon break-switches—one the field switch, the other the lighting switch. On the back of the panels are the high-tension fuse blocks.

These fuse blocks, designed for 20,000 volts, are of the snap-break expulsion type. They are mounted on pyramids of corrugated hard rubber, which contain copper spring contact clips, between which two copper blades enter, connecting the fuse block to the line. The aluminum fuse is held tightly between two arms, which are moveable around a pivot and may be pulled apart by two strong spiral springs encircling this pivot. As soon as an increase of current in the line melts the fuse, its two



Down-stream Side of Power House and Tail Race.

panel is between these and generator panels, and the exciter panel is the third panel from the left-hand end of the board.

Each generator panel is equipped with the following instruments: One inclined-coil alternating ammeter reading to 75 amperes for the generator, and one direct-current ammeter reading to 150 amperes for the field. Above each of these is a pilot lamp, and between each pilot lamp a synchronizing lamp. Beneath the two ammeters is an inclined-coil voltmeter reading to 15,000 volts, and beneath this instrument are three single-blade, double-throw, quick-break, high-tension switches, each mounted upon pyramids of corrugated hard rubber. Similar pyramids intervene at the back of the board between the bus bars and the board. The corrugations give a total distance of about 8 in. of surface between the metal clips and hinge and the surface of the marble on each side. As these switches are to break current of 12,000 volts, they are tested to break without

halves are instantly pulled apart, and thus the formation of an arc between the two halves is prevented. The melting of the fuse can only occur in a small chamber protected by wooden blocks. The whole device is covered by two vertical wooden boards. Sliding in between these wooden boards, in vertical slots, are fibre shields intended to prevent arcing over between the two arms after the separation of the two halves of the melted fuse. The two wooden blocks and fibre shields are held in position by four screws. The whole fuse block is inserted in the line simply by pushing the two blade-like copper contacts between the clip contacts, which are connected by solid copper rods to the bus bars. The wooden boards protecting the fuse are 10 1/2 in. long and 6 3/8 in. wide. The corrugated rubber pyramids on which the contacts are mounted are 3 1/2 in. high. The field rheostats are hung beneath the gallery, and are operated by hand wheels on the gallery and bevel gears below it.

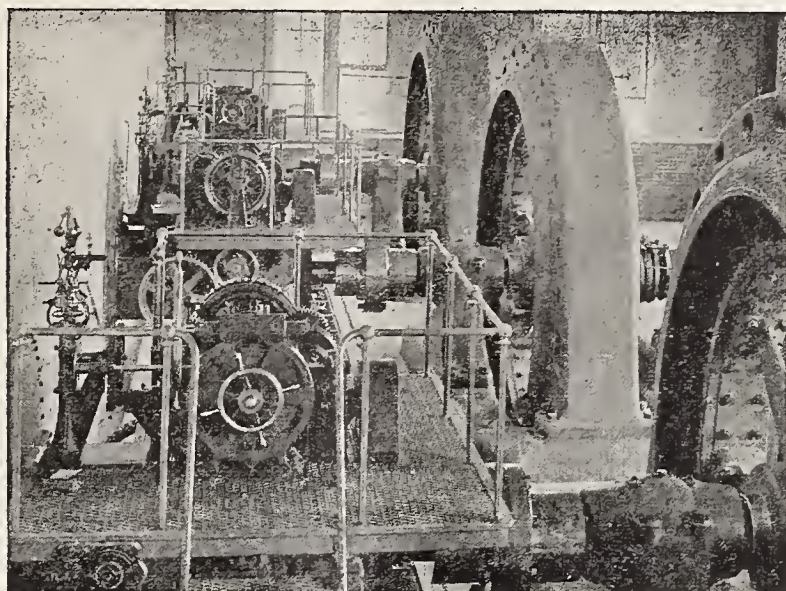
The exciter panel controlling the two direct-current

exciters carries two pilot lamps, two circular dial ammeters, each reading to 1,000 amperes; one voltmeter, reading to 150 volts; one four-point pressure switch, one synchronizing switch, two 800-ampere, triple-blade, double-throw equalizer switches, and two packed-card rheostats.

The two feeder panels are similar to each other in every respect. Each outgoing line is provided with an inde-

On the front of the output panel are two Thomson recording wattmeters for balanced three-phase circuits, each reading to 300 amperes and 12,000 volts, and twelve triple-pole, single-throw, 100-ampere switches, with fuses for the lighting circuits. On the back are four potential and two current transformers.

The lightning arresters are of the G. E. short-gap type.



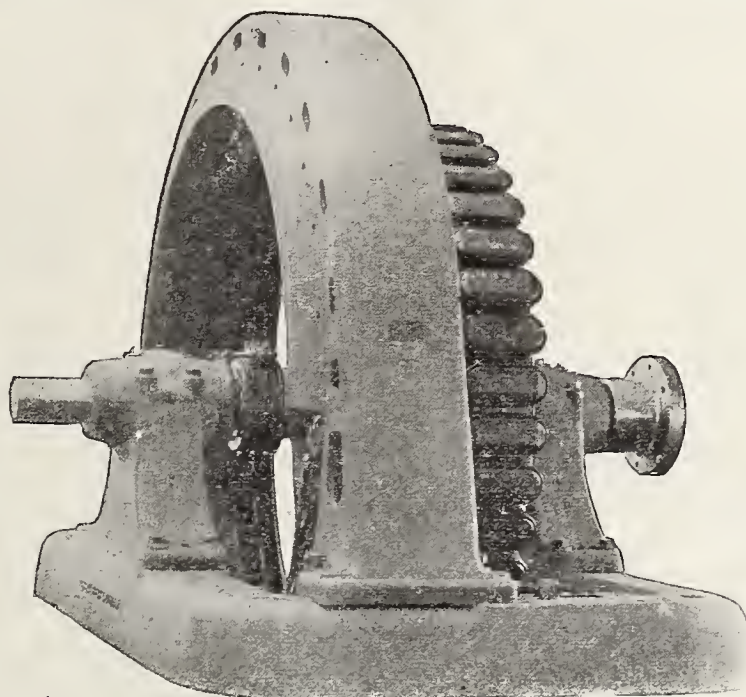
Main Wheel Governors, Tiesler Type.

pendent ammeter, reading to 150 amperes, and a quick-break, double-throw, high-tension switch similar to those on the generator panels and similarly mounted on the board. Mounted also on corrugated hard rubber pyramids are six circuit breakers, or automatic plunger switches.

These high-potential plunger switches consist simply of long copper rods sliding in hard rubber tubes. The upper ends of the rods reach into small rings in contact with which they are held by a lever catching a small rub-

Arresters of this type have been installed on nearly all of the most important long-distance transmission lines in this country, and have proved a most satisfactory protection against damage by lightning.

The principle on which this arrester operates is very simple. It allows the passage of any high-potential discharge, but effectually prevents the alternating current from following and maintaining an arc. The gap spaces in the lightning arresters at Mechanicville are very small—about 1-32 in.—each space lying between two solid



750 K. W., Three-phase Alternator. Field Uncovered.

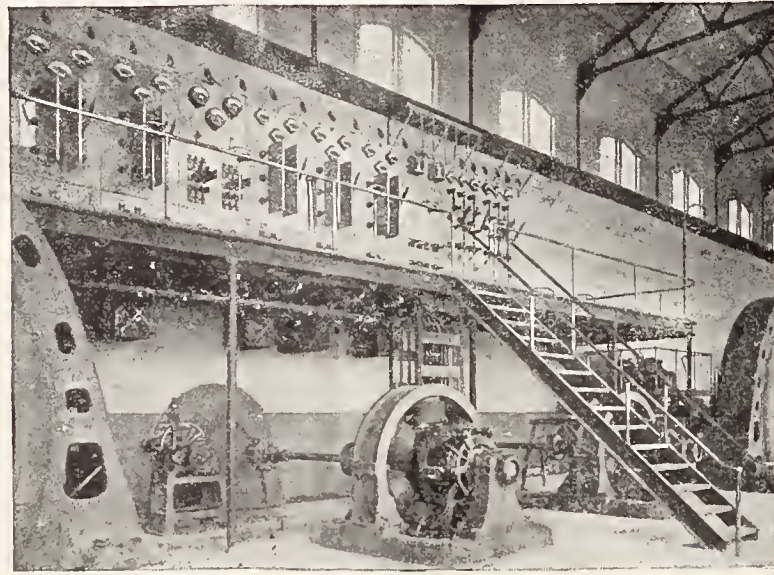
ber head on the lower end of the copper rod. This lever is held in place by a spring, and is released by moving a rocker arm on the back of the switchboard. The moment it is released a spiral spring pushes the copper rod downward, and by this movement, aided by the action of gravity, so suddenly is the contact broken that arcing between the rod and the ring is prevented. The rocker arm controls the three switches for each set of bus bars, so that they may be all released at once.

On the upper part of each feeder panel at the back is a current transformer for each outgoing line, two recording single-phase wattmeters, each reading to 25 amperes and 12,000 volts, and two potential transformers.

metal cylinders 2 in. in diameter and 2 in. long. A low non-inductive graphite resistance is placed on the circuit, and the action of the arrester therefore is dependent upon the cooling effect of the large metal cylinders, aided by the reversal of the alternating current and the introduction of the non-inductive resistance. The line is protected by double-pole, 2,000-volt arresters, connected six in series to give the necessary number of spark gaps. There are three sets of these. One at Mechanicville, grouped around the first transmission pole in a small house 15 ft. square; one set on the Schenectady side of the Glenville bridge, where the overhead pole line connects with the underground cable; and at the Works.

The lead-covered leads from the generators are taken out at the base of the machine and are laid in ducts in the floor. Rubber-covered wire is used for the field connections. The cables rise on a frame from the duct to the floor of the gallery, through which they rise to the board. From the back of the board the line wires rise to supports bolted to the I-beam on the north wall, which supports

ered necessary, and is artificially brought into the line in the shape of reactive coils in cases in which the natural self-induction is too small. The circuits are carried on poles 30 to 60 ft. long, and all 8 in. in diameter at the top. Each pole carries one cross arm, on one side of which are two porcelain insulators of the triple-petticoated type, a third being on the other side. For lightning pro-



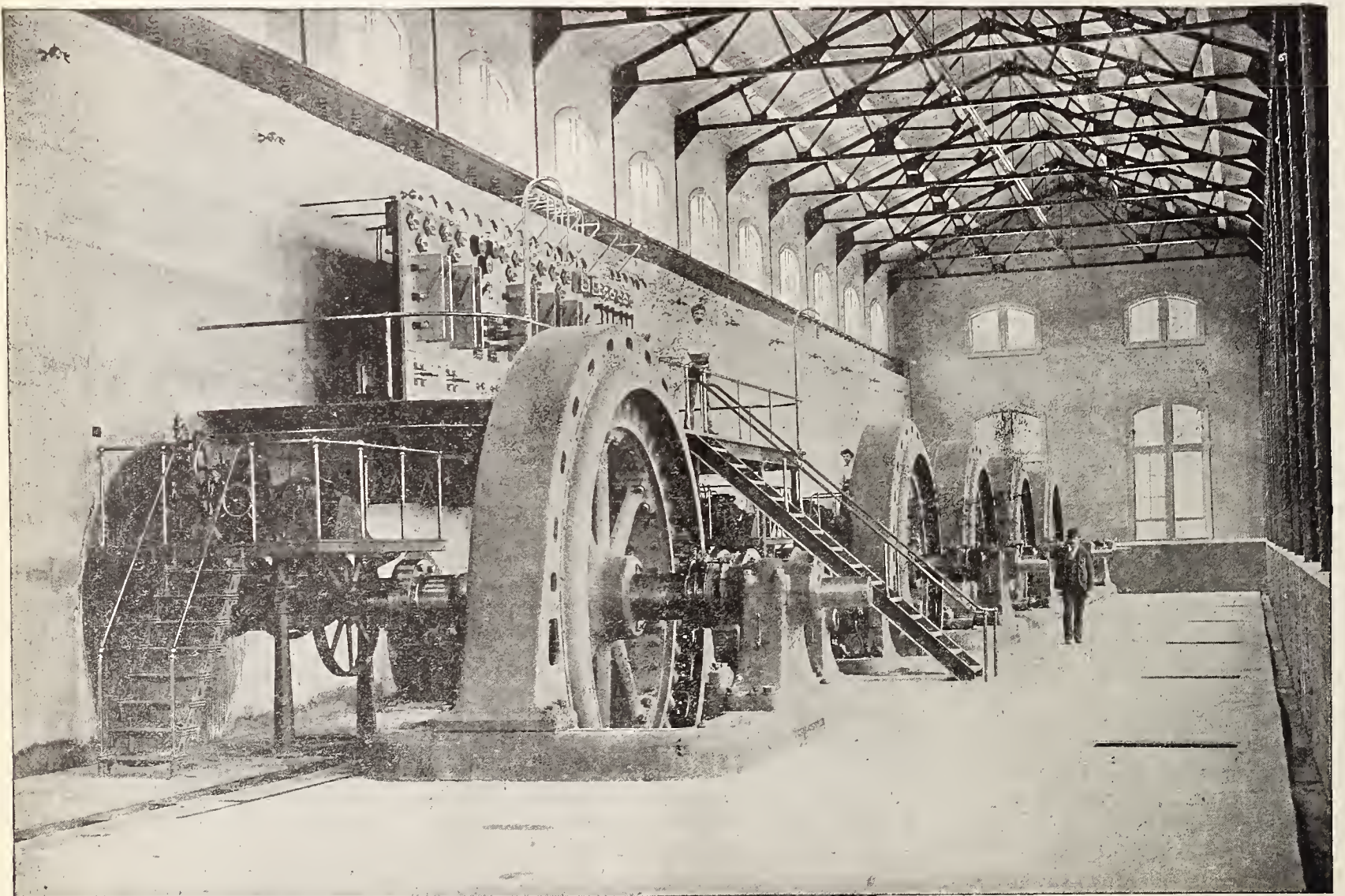
Excitors and Switchboard.

one of the crane runways. The lines run along the north and west walls and pass out to the poles through a blind window over the door of the power house.

The line from Mechanicville to Schenectady is the only one at present laid down. It consists of three No. 000 B. & S. band wire, this large gauge being employed in

tection a barbed wire, frequently grounded, runs along the tops of the poles.

The line takes a westerly direction to East Glenville and then due south to Schenectady. At the end of the Glenville bridge over the Mohawk—the town limits—it is carried down to the ground and connected to three cables



Interior of Power House. Dynamo Room.

order to give the line as high self-induction as possible. This insertion of self-induction in transmission lines is a departure from earlier practice. In cases where synchronizing apparatus is used, self-induction is now consid-

of No. 1 gauge stranded copper, insulated by 1-4 in. rubber and 3-32 in. lead sheet laid in terra-cotta conduits. These cables run 1,700 feet along Washington avenue, rise to poles again through Rotterdam street to the Erie

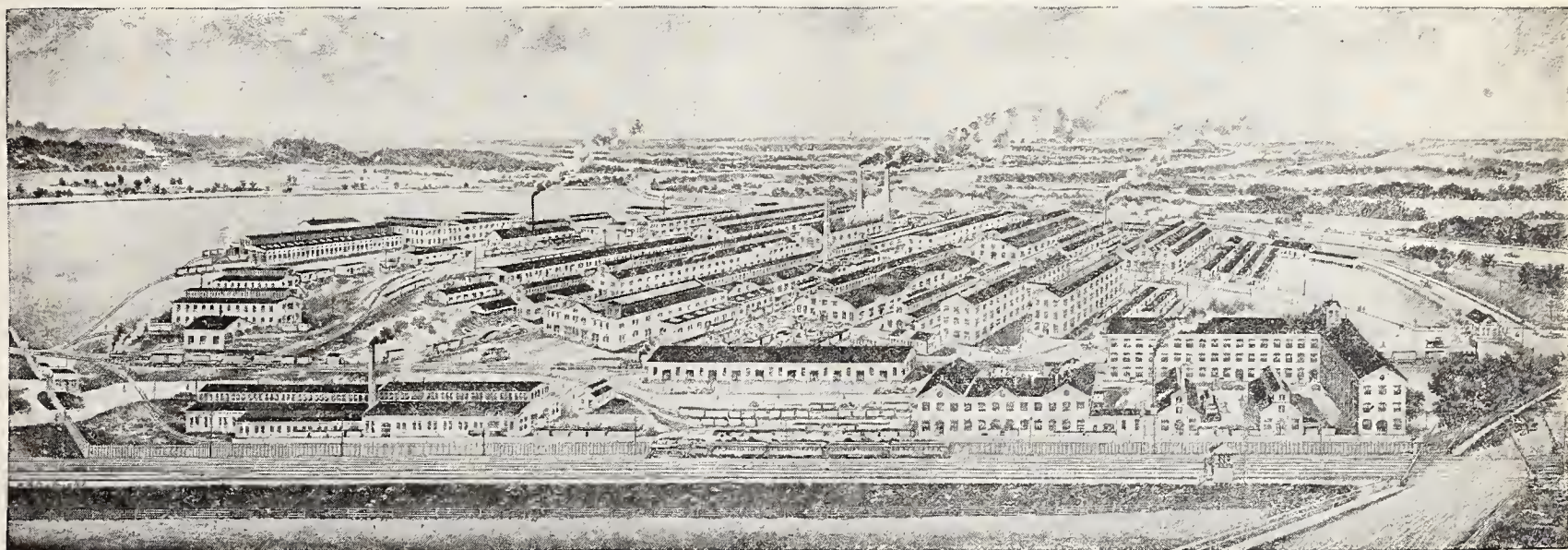
Canal, and along the canal to a point directly opposite the General Electric Company's power station. They then cross the canal and enter the Works.

The introduction of this transmitted electrical power into the factory will work a considerable change. At present all the machinery is driven by electric motors, while the testing department demands an independent supply of current for the work it carries on. There are at present, therefore, two distinct generating plants. The 550-volt motors in the testing department are supplied from an engine-driven multipolar generator of 500 K. W. capacity, while a smaller engine drives a number of ex-

bringing to the neutral a lead from their common connection.

Synchronous motors were selected in preference to induction motors on account, first, of their more constant speed and greater efficiency; second, because they do not produce lagging currents; but the phase displacement and power factor may be controlled as desired by means of control of the field excitation.

Synchronous motors of the revolving field type and of good design are self-starting, even under heavy load, and will easily carry two or three times full load without falling out of step for a time, limited only by the heating



The Schenectady Works, General Electric Co.

citers which allow of independent control of the excitation of all machines in this department. The factory is operated by a number of 250-volt motors running on the same circuit as the factory lights. These motors will not be changed, and the steam plant which supplies them will be retained as a reserve in case the power from Mechanicville should fail. The electric power plant superseding the present steam plant at the works will, therefore, consist of two synchronous motors, one of 500 K. W., the other of 100 K. W., and three 400 K. W. rotary converters—the synchronous motors for the testing department, the converters to supply current to the factory motors.

The large engine driving the 500 K. W. multipolar generator is superseded by the 500 K. W. synchronous motor. This is a 12-pole, 400-revolution machine of the revolving field type, wound directly for 10,000 volts. The small engine driving the exciters is replaced by the 100 K. W. synchronous motor—an 8-pole, 600-R. P. H. revolving field machine similarly wound. This disposition renders this department independent of everything but the speed of the Mechanicville generators, which will be kept as nearly as possible constant.

The three rotaries supplying 250-volt current to the factory motors are 10-pole, 400-K. W., 480-R. P. H. machines, having two commutators and two sets of collector rings, connected to independent windings on the armature. They receive the three-phase current from independent secondary coils of the same set of air-blast transformers. When connected in multiple they furnish current at normal pressure of 250 volts, but, as they may be called upon to furnish current to the testing department in case the demand exceeds the supply from the synchronous motor-driven machine, they may be connected in series to give 500-volt current, operating in parallel with the railway generator, driven by the synchronous motor in the testing department.

The rotaries are operated in parallel, and all the factory motors, the factory railway and all the factory lighting are operated from the same direct-current circuit, the latter on the Edison three-wire system, the neutral wire of the three-wire system being secured by connecting the transformers for the rotaries in Y with their secondaries and

of the motor.

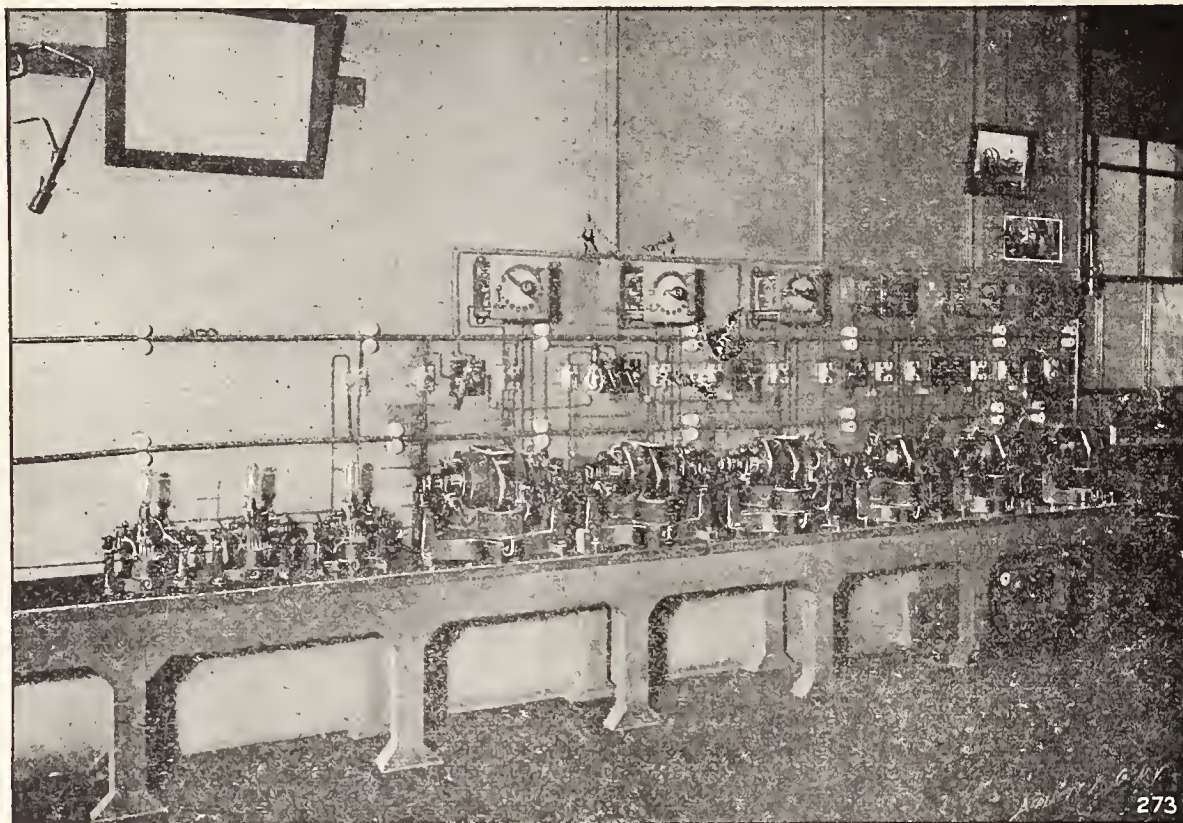
To make the entire Works system self-regulating in the direct-current distribution and, as far as possible, independent of hand regulation, the rotary converters are given shunt field and powerful series field, so joined together that the machines operate as one unit. With constant voltage in the generating station at no load, the counter E. M. F. of the rotaries as given by their shunt field is below the impressed E. M. F. and a lagging current is produced. The self-induction of the lines is thus in opposition to the voltage, which is so reduced as to give 250 volts at the commutator brushes of the rotaries. As the load increases, the counter E. M. F. of the rotaries rises, due to the series field, until at full and over-load it is greater than the impressed E. M. F., and the current becomes leading. The E. M. F. of self-induction of the lines is then brought partly in phase with the voltage, which is increased so that, in spite of the increased line current and consequently increased energy loss in the line, with constant generator voltage, the same voltage is produced at the commutator brushes of the rotaries at no load as at full load and over-load. This control is, therefore, automatic in every way and, did the synchronous motor not take current over the same line in varying quantities, would suffice. To render this control perfectly automatic, therefore, small series transformers are inserted in the lines leading to the synchronous motor, feeding a small synchronous motor generator controlling the shunt field of the rotaries. By the combined action of their shunt and series field, the voltage is automatically maintained constant at the commutator brushes of the rotaries, and no hand regulation is required beyond that of readjustment in case the number of rotaries in operation is changed.

The entire construction of the dams, power house and lines has been carried out with the highest engineering skill by the National Contracting Company, of which G. H. Furman is general manager, E. A. Mathews, superintendent, and J. A. Leonard constructing engineer. The electrical equipment is furnished by the General Electric Company, and the hydraulic equipment by the Stillwell-Bierce & Smith-Vaile Co., of Dayton, O., to which com-

pany was confided the entire development contract. It took the Hudson River in its natural condition and turned over to the operating company the plant in running order.

The officers of the Hudson River Power Transmission Company are:

It is universally acknowledged that hand-made rugs, shawls, carpets, etc., fetch a higher price than those made by machine, but the consumer of today is one supplying profit to thousands of manufacturers by buying the less valuable though just as serviceable machine-made



Electrically Driven Telegraph Plant. 20 Dynamotors. Western Union Telegraph Co., Buffalo, N. Y. 1894.

General Edmund Hayes, of Buffalo, N. Y., president; R. N. King, president of Stillwell-Bierce & Smith-Vaile Co., of Dayton, O., vice-president; G. H. Furman, Newark, N. J., treasurer; Mr. E. J. Richards, Boston, Mass., superintendent; J. S. O'Shea, manager.

textile goods.

When the looms of England were driven by steam great riots resulted, but as people grew accustomed to this innovation those that fought against it found themselves better paid and consequently better clothed, fed



Electrically Driven Telegraph Plant, 25 Dynamotors. Postal Telegraph Co., Main Office, New York. 1894.

WEAVING BY ELECTRICITY.

One of the oldest arts in the world is that of weaving. The fabrics of the Far-East, including India, China, Japan, Turkey and Persia, have been famed from time immemorial, and even today the textile products of these countries represent one of their most important sources of revenue.

and housed, and the direct use of the hand came into play for the manipulation of great machines.

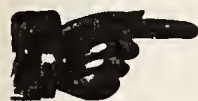
Electrically driven looms, as represented in this illustration, appeal to our sense of progress as the next and most reasonable step and advance. It is likely that the introduction of the motor for driving weaving machinery will become so widespread as to ultimately affect the price of woven goods for the benefit of the purchaser.

The Electrical Age.

ESTABLISHED 1883.

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A USEFUL PRODUCT OF THE ELECTRIC FURNACE.

Practical investigations and experiments have shown the commercial world that carborundum, a product of the electric furnace, is exceedingly valuable and may replace many of the materials formerly used for grinding and polishing. Carborundum, or carbide of silicon, is prepared in a furnace consisting essentially of a large metallic receptacle, a carbon rod supported in the middle and a mixture of carbon and clay, through which a very strong current is passed, the holder of the material and the carbon rod serving as electrodes. In a furnace of this description a fusion of carbon and clay takes place, with the result that in the course of time, after the gases, etc., have escaped and the furnace is allowed to cool, clusters of crystals have formed inside the interior of the mass, presenting the appearance of a geode.

This primitive form of furnace has undergone several modifications since the value and utility of corborundum have been recognized. Mr. Atchison, a gentleman whose name has been connected with the development of the trade in carborundum, used glass sand and a little salt instead of clay, thereby producing a much purer type of carbide of silicon than ever before.

The heaviest amounts of carborundum manufactured did not exceed one-quarter of a pound per day, but since a demand for it has increased, thousands of pounds are produced per week in very large furnaces, some of them over nine feet long. It requires about two thousand horse power hours to produce three hundred pounds of carborundum, or an average of seven horse power hours per pound. The mixture which is shovelled into the furnaces at Niagara Falls consists of a well-reduced mass of heterogeneous materials, such as coke, saw dust, sand and salt, which, in certain proportions of each, are reduced in a furnace to continued incandescence and subsequent crystallization.

Wherever power is cheaply developed there are sufficient manufacturing concerns in the immediate vicinity or within a radius of limited extent able to use many pounds of carborundum, in consequence of which making it a paying investment to erect a plant for that purpose.

This represents the conditions met with at Niagara Falls, at which the Carborundum Company have established their plant. The details of construction and technical features of this establishment are deeply interesting to the electrical engineer. It is surprising to realize how short time has elapsed since the discovery, use and manufacture of carborundum has become a fixed thing. As this material will scratch and cut all precious stones but the diamond, it necessarily follows that its field of application is enormous, and such is the case.

Emery wheels have found a great rival in those made of carborundum, and the various powders sold for polishing and preparing the surfaces of metals have been set aside for this new, strange, and, in many respects, remarkable product.

Within the furnace in which carborundum is formed pieces of pure carbon are found. The coke is exposed to so great a temperature that it is reduced to the purest graphitic form. Many of the carborundum crystals are quite light in color and might be mistaken for a diamond if cut and polished. The products of the electric furnace, in the form of acetylene or carbide calcium and carbide of silicon, carborundum, are now of the greatest service to the domestic and industrial world.

We can trace some of the most brilliant discoveries of earlier chemists to simple experiments with the electric furnace, and it is highly likely that the list will not end with carborundum, which is, in most of its characteristics, the nearest semblance to an artificial diamond, with the exception of Moissan's gems, that we have produced. As a further proof of this last fact, we may state that a sheet of glass was scratched with a crystal of corundum, carborundum and the diamond. Upon examination of these scratches with the microscope, the discovery was made that the lines made by the carborundum and diamond were identical. As far as its competition with emery is concerned, not the slightest doubt remains in the minds of practical men regarding the infinite superiority of this unique crystal.

THE RISING PRICE OF RUBBER.

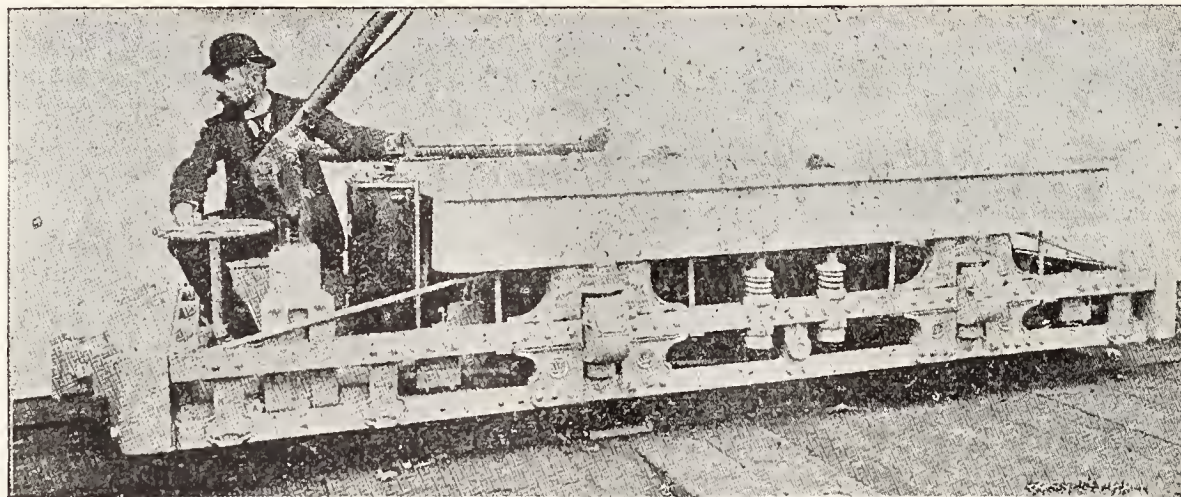
Two indispensable materials to electrical manufacturers are rubber and copper. As far as the latter is concerned the great mines of this country have and will produce sufficient to meet all our requirements. The great Anaconda mines of the West, supply millions of tons per year to the East and other large institutions of a similar nature, making a temporary exhaustion of this valuable metal almost impossible. But the item of rubber which is used for the insulation of wires is one requiring serious consideration. The United States is forced to obtain its supply of rubber from South America. Perhaps no more profitable investment could be made by a shrewd capitalist during these times than in a tract of ground filled with rubber trees.

The demand for rubber has grown of late far beyond the expectations of the most sanguine-minded. Rubber bicycle tires, rubber wearing apparel, a host of medical appliances, and finally, rubber-covered wires, have caused the supply to be unequal to the demand—a demand which increases daily. An excellent opportunity is presented here for some ingenious inventor to produce a substitute for rubber, if not for all the other purposes mentioned above, at least for the insulation of copper conductors.

Foreign chemists and Prof. Fessenden suggested the use of cellulose, and we believe that its high insulating properties, durability, etc., make it well worthy of trial. In a note received from Consul-General De Leon, of Guayaquil, the statement is made that the culture of rubber trees has been started in Ecuador, in which rubber was previously obtained from wild trees. The government is taking an active interest in this matter and Ecuador may be regarded in the future as one of the important centres of supply.

The Crocker-Wheeler Electric Company, of Ampere, N. J., equip this particular class of machinery with motors direct-connected, thereby providing for proprietors and hands the acme of convenience and a means of reaching the highest point of economy attainable. The

the directors of a telegraph company at all central stations is a foregone conclusion, and it seems likely that the stock circulated by these concerns, gilt-edged as it was in the past, will harden into golden sheets in the light of this interesting departure.



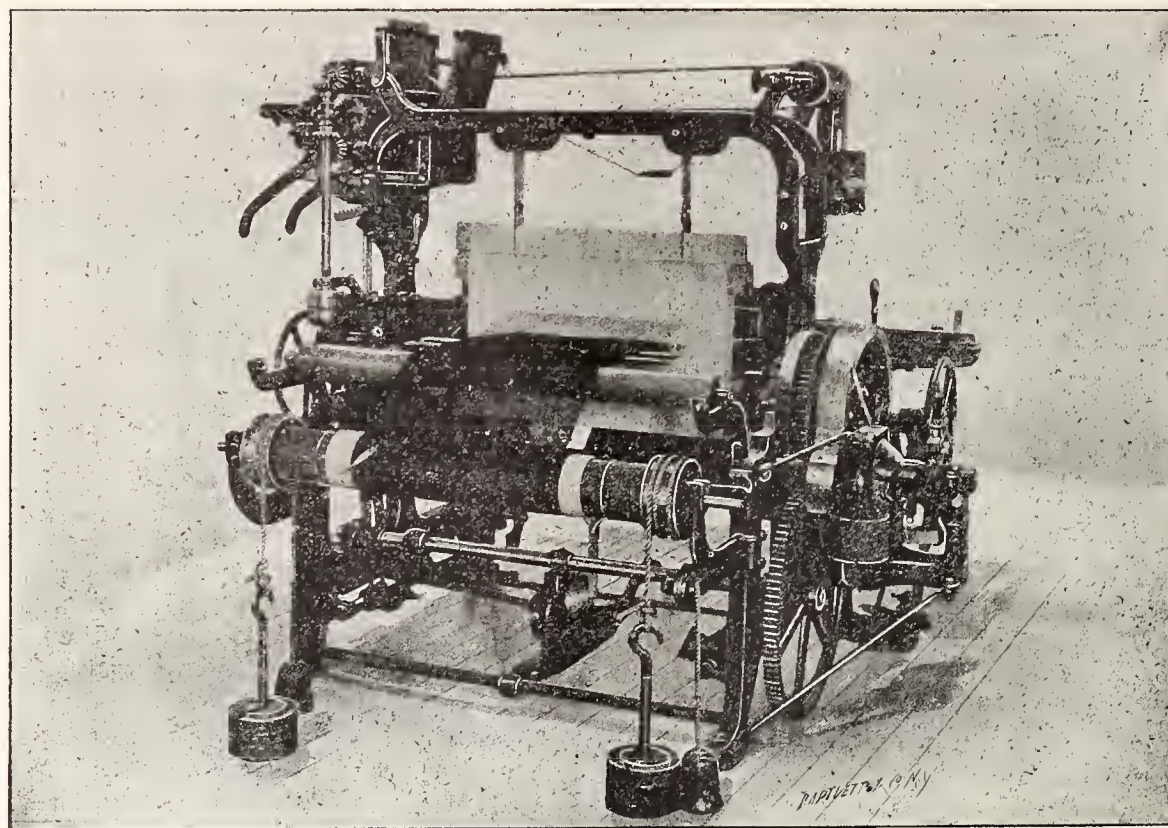
The Peckham Mining Truck.

above concern have shown their enterprise by installing the Western Union Telegraph Company office in Buffalo, N. Y., and in the Postal Telegraph Company's main office in New York, twenty and twenty-five dynamotors respectively, which take the place of innumerable cells of blue-stone battery formerly used.

One of the first applications of the dynamo in place of primary batteries was made in 1879 by Stephen D. Field, of San Francisco. A plant of fifteen dynamos used by

MINING TRUCKS.

The mining truck is so designed that it finds its use on street railways for freight and general engineering purposes. The extension of the side frames at one end provides a platform, as seen in sketch, for the motorman, controller, brake wheel and trolley supporter. A very substantial platform built over this truck serves the purpose of carrying tools or any other machinery required



Motor On Silk Loom, In Operation, Motor At Right. Crocker-Wheeler Electric Company.

the Western Union Company in their New York station does as much work as that of thirty thousand gravity cells. By using the dynamotor, however, the regular electric-light current of one hundred and ten or two hundred and twenty volts may be sent into these machines and transformed down to the pressures used on ordinary lines, or if necessary raised to whatever potential is required. From a commercial standpoint the introduction of dynamotors marks an epoch in the history of telegraphy that speaks well for those entrusted with its present development. An immense amount of space, considerable inconvenience and much money is saved by these ingenious devices. Their universal adoption by

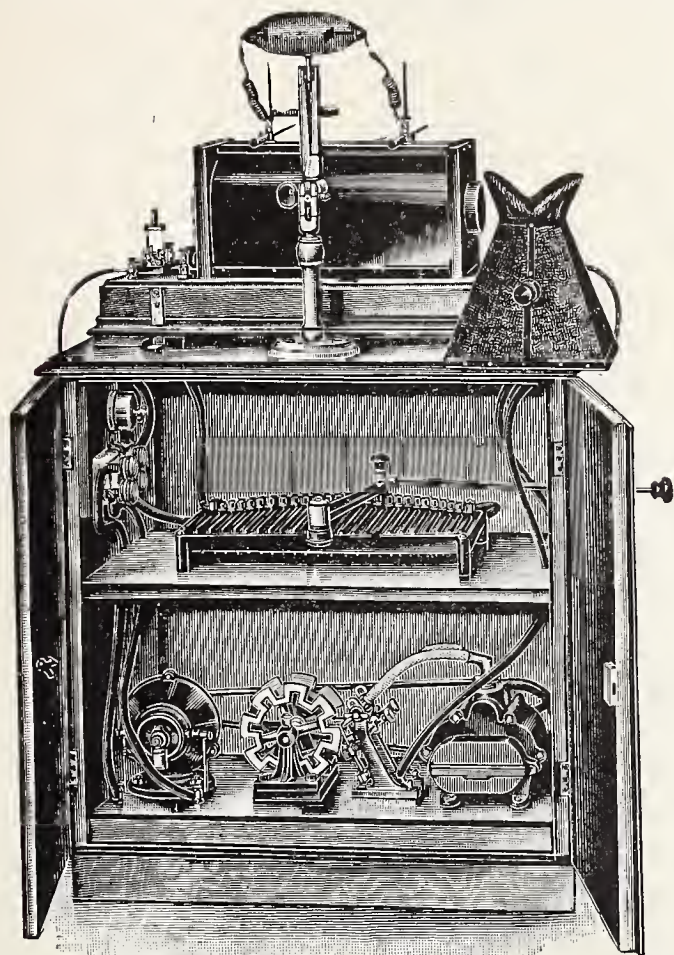
for repairs, etc. This truck is manufactured by the Peckham Motor Truck & Wheel Company, and represents a most substantial and convenient accessory to street railway repair shops.

Cleveland, Tenn.—The Cleveland Electric Light & Power Company has been incorporated by W. W. Cunningham, Frank Spurlock, Foster V. Brown, John C. Ramsay and C. A. Danals. Capital stock, \$10,000.

Camden, N. J.—The Union Electric Co. has been incorporated.

THE EDISON PORTABLE CABINET X-RAY OUTFIT.

At the beginning of the Santiago campaign the necessity of equipping the hospital ships with efficient and powerful X-ray apparatus was immediately perceived by the Surgeon-General of the United States Navy, who realized the importance of installing apparatus which should be the most powerful of its kind, and also which should be



Edison Manufacturing Co.'s Portable X-Ray Outfit.

so simple in construction and operation that it could be properly handled by any ordinary mechanic. An order was therefore placed with the Edison Manufacturing Company for one of their latest Portable Cabinet X-ray Outfits, to be placed on board the United States Hospital Ship "Solace," and the entire apparatus was placed in position ready for use within forty-eight (48) hours after the placing of the order. A brief description of this apparatus, which is illustrated below, may be of interest to our readers.

The cabinet, which is made of polished quartered oak of massive construction, occupies a floor space of two feet eight inches by one foot eight inches, and is furnished with four wrought-iron Ls screwed on to the base of same, by which it can be rigidly fastened to the deck. This is most necessary, as in case of heavy weather the apparatus might be damaged by the ship rolling if it were not firmly attached in this way.

The Edison coil, which is mounted on the top of the cabinet, is also furnished with brass Ls and strips to hold it firmly in position, and the base of the adjustable focus tube stand is similarly screwed to the top of the cabinet. The upright part of the focus tube stand has a wooden screw at the end of same, by which it is attached to the base, and when the focus tube stand is not required to be used, it is only necessary to unscrew the upright from the base, which can be done in a moment.

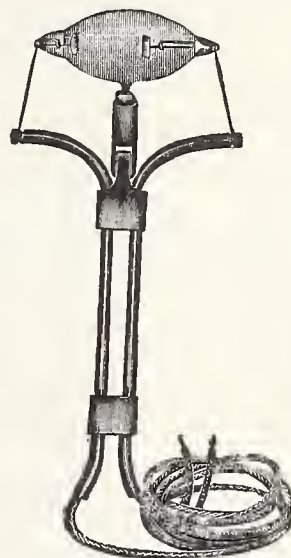
The distinctive feature of the Edison Electric Light X-ray Outfits is, that there is no vibrator on the induction coil, its place being taken by the instantaneous air-break-wheel device shown in the bottom part of the cabinet.

This device consists of two tooth-wheels mounted on the same shaft. The projections or teeth make contact with two flat brushes which bear on the outer peripheries,

and by which the current is brought in and led out again. These wheels are rotated at a very high speed, by a small direct-current motor, which also runs a pressure-blower. The air blast from this blower enters a bifurcated tube and is conducted to two flat nozzles immediately over the contact brushes.

When the device is set in operation by starting the motor and connecting the primary of the Edison X-ray coil in series with the binding posts (attached to the break-wheel) provided for this purpose, the spark formed at the contact brushes, when the coil is energized, is instantaneously blown out by the air blast at the moment of formation. This greatly increases the rapidity of change in the magnetic circuit, and consequently vastly augments the electromotive force in the secondary coil.

The controlling rheostat shown on the upper shelf of



Edison Manufacturing Co.'s Portable X-Ray Tube.

the cabinet is used to vary the current in the primary of the Edison coil, and the lever arm of the rheostat is connected to the extension rod passing through the side of the cabinet so that the doors of the cabinet can be closed and the rheostat actuated by means of this extension rod, which is shown on the right-hand side of cut. The main switch is shown on the left-hand side of cabinet, near the top, and the cut-outs directly underneath same. The advantage of this arrangement is seen at a glance, as the keys of the cabinet are always in the possession of the chief surgeon on board ship, and it is impossible for anyone to use the apparatus without his permission.

The coil is protected by a polished oak cover (not shown in the cut), which fits over the top of cabinet, and in which room is left for the fluoroscope to fit into, so that the apparatus is entirely protected when not in use. The operation of the apparatus is exceedingly simple. The focus tube is clamped in the jaws of the focus-tube stand and connected to the secondary binding posts of the Edison coil by two highly insulated thin wires.

The doors of the cabinet are now opened and the main switch is turned, which starts the motor and the pressure blower in operation. The doors of the cabinet are now shut, in order to economize space, and the reversing switch shown on the left of the coil is closed, so that the secondary current from the coil is increased by gradually drawing out the extension rod attached to the lever of the controlling rheostat.

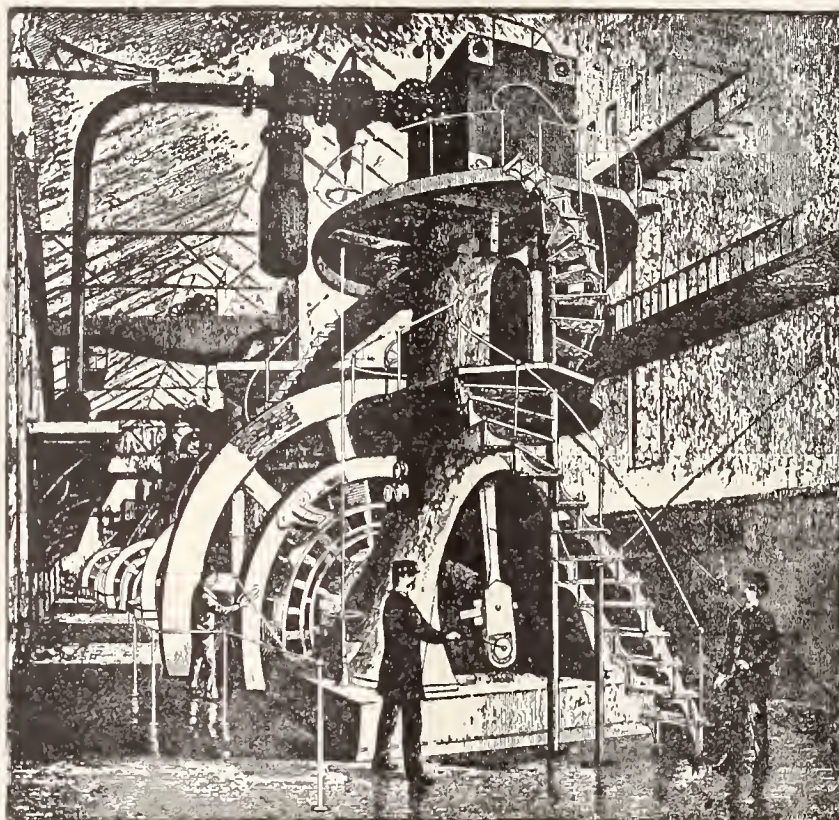
The patient is now placed in front of the focus tube and the fluoroscope placed behind the limb or that portion of the trunk that it is desired to examine. In cases where the patient is so seriously wounded that it is necessary for him to maintain a reclining position, the focus tube is attached to the portable focus-tube holder, as shown in Cut No. 2, and the focus-tube stand is dispensed with. The ends of the portable-tube holder wires, which are very highly insulated, are now attached to the secondary binding posts of the coil. These heavily insulated connecting wires are several feet in length and the portable focus-tube holder is made of hard rubber so that it

can be handled easily, without fear of shock to the operator.

The portable focus-tube holder with focus tube is now placed underneath the cot or operating table, and the surgeon makes his examination by looking through the patient from above.

"Proposed New Electric Elevated Railroad in Boston." A brief article on the proposed construction.

There are also several special contributed articles in which the reader may be interested, together with descriptions of many new improvements in electric rail-roading.



A Great Chicago Plant, Purely Metropolitan In Nature.

The entire apparatus is substantially and strongly made, and is also of handsome design, and the work that has already been done with it has shown the great value of such an apparatus in warfare, and the necessity of equipping all naval, marine and military hospitals with a device of this kind.

One great advantage possessed by this apparatus is that it can be moved from place to place without delay, as the cabinet is mounted on heavy casters, and it is only necessary to disconnect the attachment plug and cord attached to the main switch from the receptacle into which it may be screwed, and the cabinet may then be moved to any part of the ship or hospital and attached to another receptacle by screwing in the attachment plug, which will not occupy any time whatever.

We understand that the Edison Manufacturing Company have one of these cabinets in operation at their show rooms, St. James Building, Broadway & 26th street, New York.

REVIEWS.

The regular September number of the Street Railway Journal has been made a souvenir of the Boston Convention of the American Street Railway Association, and is, we believe, a most unusual publication in size, in typographical appearance, and in the character and quality of its reading matter. We call your special attention to the following articles:

"Street Railway Conditions and Financial Results in Metropolitan Boston." This, the leading article, is devoted to a financial analysis of thirty-one street-railway properties in and about the city of Boston. These are suburban and interurban in character, and a comparison of their financial characteristics is for various reasons of special interest to street-railway capitalists.

"The Boston Subway." In this article is described in considerable detail the latest plans of the subway stations as finally carried into effect.

THE THREE TYPES OF STATIONS.

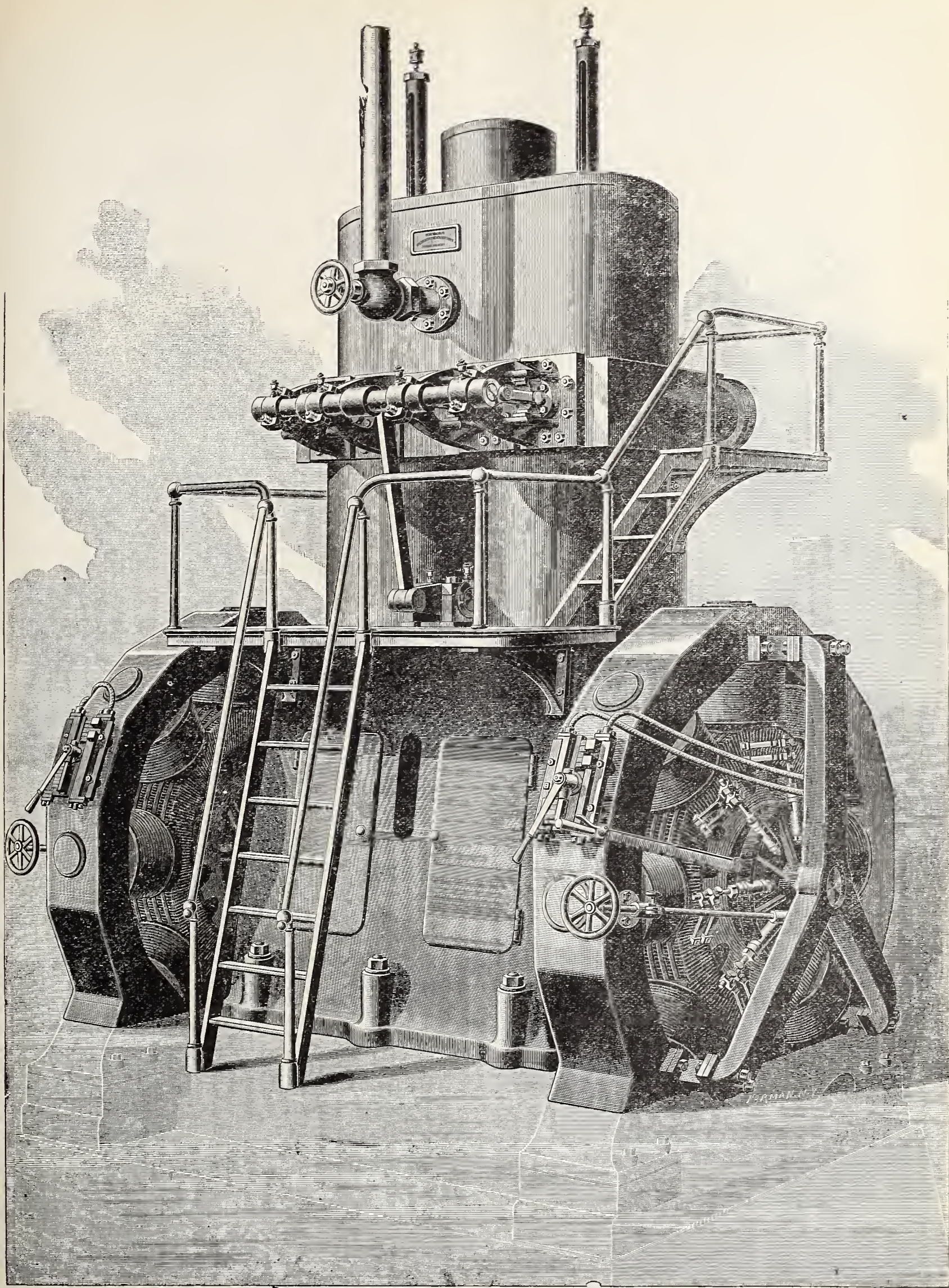
We find on examining electric light and power stations that they are naturally divided up into what may be called

1. Metropolitan,
2. Suburban,
3. Small city or town

station. This division is all the more true when the size and utility of each power centre is considered. In any electric light or power plant it is a good thing to give the boiler plenty of room. The manufacturer will generally express his opinion very strongly on this point. The laying out of an electric light station or large power plant depends upon a few simple principles.

First, a knowledge must be obtained of the number of lights wanted or its equivalent, the horse power to be supplied. Canvassing the district will determine this. Then the dynamo, with regard to size, speed, etc., must be selected, and, finally, the engine, whether large or small. In some of our model stations found in New York the coal is on the upper floor, the dynamos below, and the engines and boilers on the ground floor. The system prevailing at present is that of having engines and dynamos directly coupled, thus saving considerable space. Direct coupling is not always the best practice in a station running arc and incandescent lights. In such a case belting is usually resorted to. In the year 1800 very large engines of the Corliss type were employed, governed entirely by the throttle valve. Today the art has so developed that regulation is automatically effected by a thorough understanding of slide-valve regulation.

In 1882 the Porter-Allen appeared, possessing features of great interest to electrical and mechanical engineers. The high-speed engine for station use is valuable because steadiness of action is secured throughout the stroke of the engine, and the small space the engine occupies is considered a great advantage in metropolitan plants. Of course, the reader will understand that the Van Vleck vertical type of engine used in the Pearl



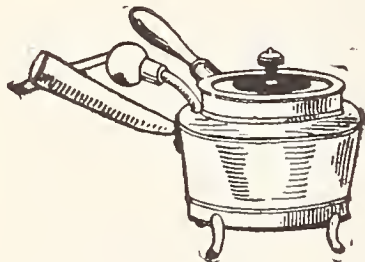
A Direct Connected Plant Occupying Little Floor Space. (See Three Types of Stations.)

street stations of the Edison Electric Illuminating Company occupy very little floor space and run at a slow speed. This company likewise used Porter-Allen engines in earlier days, but abandoned them on account of the slow

action of the governor. The Armington and Sims, Buckeye, Ball and Wood, and other types of engines were introduced and worked successfully. This was attributable to the fact that their governors started instantly and

did not overshoot, a spring being much better for good regulation than a weight in the governor.

Although these changes occurred, the difference between installations in the heart of the city, at its walls, so to speak, and in the country, became more and more marked, and gave rise to what might truly be called the three types of stations. The machinery in each of these varies in many details. In the first place, the metropoli-



Electric Cooking Utensils.



tan station utilizes gigantic generators and prime movers. The suburban station, rather hybrid type of machinery, consisting of alternators and arc-light machines, while the country station may vary slightly from this in type of machinery and greatly in size.

Modern science has at least decided that compound-wound, continuous-current generators and slow-speed engines are more economical to use in large plants than any other combination. Also that storage batteries are a highly desirable adjunct, which may frequently be found on the continent in the first two kinds of station, and appear in this country only in connection with large metropolitan plants.

The two classifications formerly made, dividing electric light plants into central stations and isolated plants, have given way to this third later and more interesting division, the metropolitan, country and suburban plant.

COOKING BY ELECTRICITY.

The desirability of electricity and its superiority to all other forms of energy as an agent for the preparation of food is beyond question. The high efficiency of all electric heating apparatus is so pronounced that the general use of electric kitchen utensils is solely dependent upon the cost of electricity. The large companies supplying light and power to city residents are having and will soon have a bigger problem to wrestle with than they anticipate. Like gas, electricity has come to stay, and its popularity is now so manifest that people living in large, well-equipped apartment houses consider the use of electricity in the kitchen indispensable to their comfort. This new and growing phase of the problem is appealing more and more to the commercial instincts of the directors of companies selling electricity.

The dual interests of these concerns and manufacturers of electric cooking apparatus go hand in hand. Dollar gas has been won in this city; let the price likewise fall in connection with electricity used in the kitchen or even for heating the home. The time is ripe for it, and the income derived by electric light and power concerns will, by this reduction, increase enormously and last much longer than the temporary profit of the manufacturers of this apparatus.

There is no reason why electricity should not rule the household, not of the wealthy or independent tax payer, but that of the man in average circumstances, who is taught to regard such an innovation at this present hour as an unseemly luxury.

Wichita Falls, Tex.—City Clerk may give information concerning contemplated establishment of electric light plant.

NEW ELECTRIC STREET RAILWAY.

The city of St. Thomas heretofore has had practically no street railway accommodations, there being in operation only about $1\frac{1}{4}$ miles of 3-foot-gauge horse-car road. A new electric trolley system was completed on June 15. The road is a belt line, 6.1 miles in length, running around the city. With the exception of the overhead

joints and fixtures, which were purchased from the Ohio Brass Company, of Mansfield, the line was built and equipped with Canadian material, the total cost being \$85,000. The rails were made at Hamilton, Ontario; the engines at Amherst, New Brunswick; dynamos and electrical equipment were purchased of the Canadian General Electric Company, Toronto; and the motors, eight in number, and two trailers were manufactured by the Ottawa Car Company. The motors are the latest pattern double controllers, and cost \$2,800 each.

It is intended to extend the line to Port Stanley, nine miles south, and possibly to London, 15 miles north.

The city of St. Thomas has also under construction this summer a new city hall costing \$45,000, two new public schools costing \$50,000, and is repaving the business district with vitrified brick instead of cedar blocks. There is a marked aspect of prosperity in all directions throughout the district, which is increasing each day as the harvest yield becomes more positively assured.

M. J. Burke,
Consul.

St. Thomas, July 30, 1898.

Vineland, N. J.—American Electrocare Co. has been incorporated by Benjamin F. Ladd, Eli B. Hendee, George Davidson and others; to manufacture and sell electrical appliances for curative purposes. Capital stock, \$100,000.

Cleveland, Tenn.—The Cleveland Water & Electric Light Co.'s plant has been purchased at receiver's sale by W. W. Cunyningham for \$36,500.

Camden, N. J.—Union Electric Co. has been incorporated to generate and sell electrical current for heat, light and power. Capital stock, \$6,000.



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WATTMETERS**

For Alternating and Direct
Current Circuits.

The only standard portable instrument of the type deserving this name.

Write for Circulars and Price Lists
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WESTON ELECTRICAL INSTRUMENT CO.
114-120 WILLIAM STREET, NEWARK, N. J.

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The agitation and alarm in the public mind at this time give an extraordinary value to the services of a paper like The Tribune.

There is a general reaction among all intelligent classes against the exaggeration, extravagance, bogus news, guesswork and typographical hysterics of the sensational papers.

The Tribune is the only morning newspaper in New-York, not of this class, which not only enjoys the comprehensive Associated Press service but has an elaborate system of special dispatches from its own representatives at every Camp, in every Army and with the Fleets.

The paper which will suit you the best and give you the most is The Tribune. It does not magnify skirmishes into terrible battles; and it does not exaggerate things of which it has special and exclusive news out of all proportion to their importance.

Its scrupulous desire to give the exact truth and nothing else is well known to the Army and Navy. In consequence, its correspondents have special facilities for learning the exact facts.

The Tribune is also particularly strong in Business News, covering the matters which every practical man must have for the successful conduct of his business.

Its great page of Open-Air Sports and Sportsmen is attracting the attention of every one. A contemporary says: "For a long time the cycling department of The Tribune has been in the hands of one of the most competent experts in the country, and its racing specialist is as well known for his picturesque language as for his accurate knowledge of horses."

Subscription price: Daily and Sunday, \$1 a month; \$2.50 for 3 months; \$10 a year.

THE TRIBUNE,
New-York.

General Electric Co.'s NEW X-RAY TUBE

With Automatic Vacuum Regulator.

No more Troubles from High Vacuum Tubes.

SIMPLE AND EFFICIENT.

Keeps Vacuum Adjusted Automatically. Can not run too high in Vacuum for Operation. Life practically unlimited.

Roentgen-Ray Exciting Apparatus: Thomson Inductoriums, Thomson Roentgen-Ray Transformer Sets, Fluoroscopes, etc. Catalogue No. 9050.

Miniature Lamps: Candelabra, Decorative, Battery and Series. Catalogue No. 9044.

**Edison Decorative and Miniature
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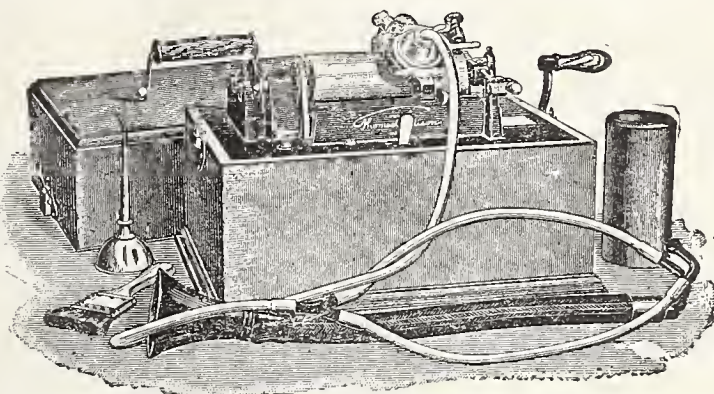
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Records Reproduces, shaves off cylinders, has sapphire points. Runs 3 records with one winding of spring.

Weight, 17 lbs.

Complete, as per illustration,

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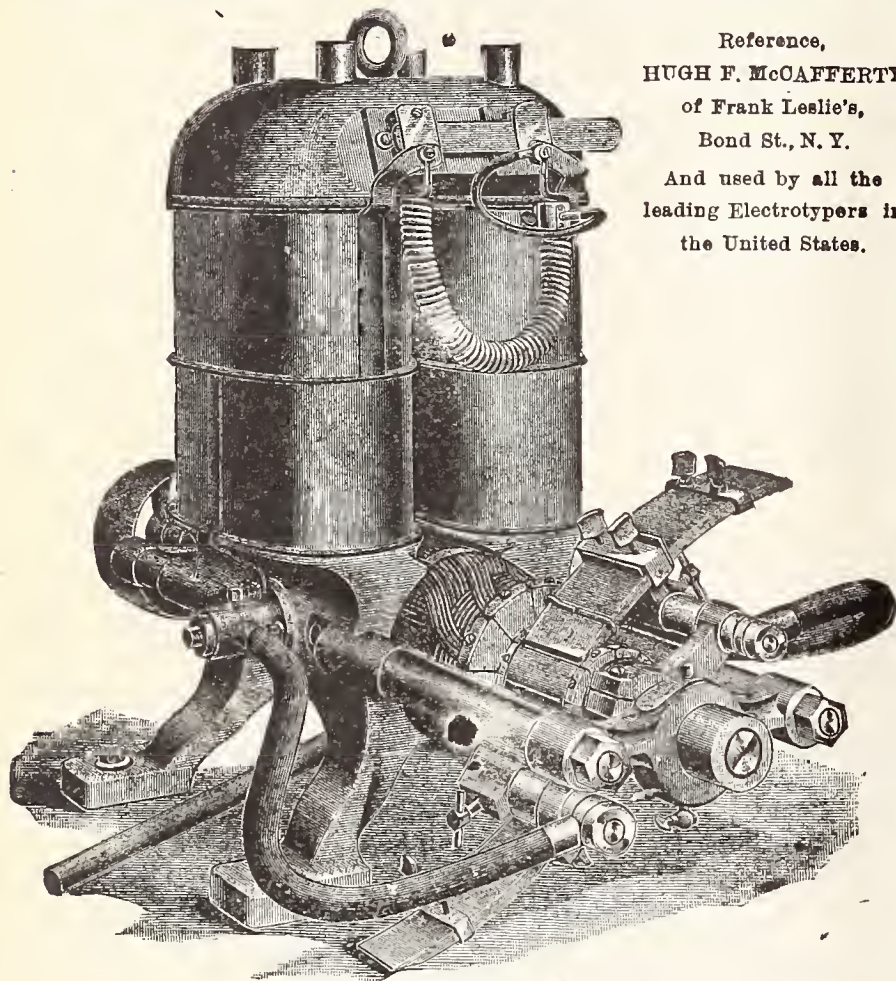
THE WORLD DYNAMO

WILL PRODUCE A SHELL IN 30 MINUTES.

Manufactured by the

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And used by all the
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*SWITCH BOARDS,
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WORKS AND OFFICE:

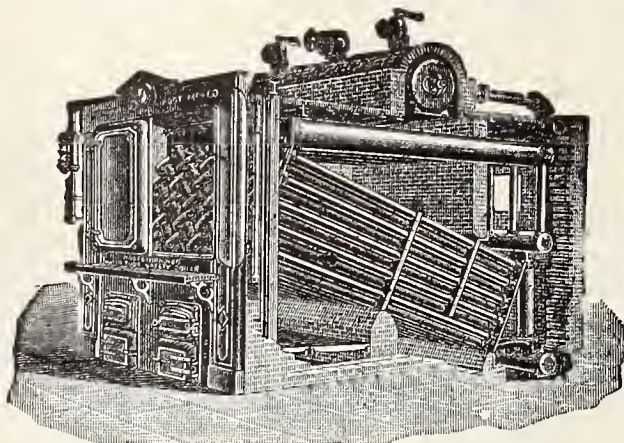
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BROOKLYN, N. Y.

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Examine these Points in the Improved Root Water-Tube Boiler.

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ABENDROTH & ROOT MFG. CO., 28 CLIFF ST.,
NEW YORK CITY.

The Electrical Age.

VOL. XXII—No. 12

NEW YORK, SEPTEMBER 17, 1898

WHOLE No. 592



Locomotive and Train at Lockport.

THE BUFFALO & LOCKPORT ELECTRIC ROAD.

The most recent application of electricity to the steam railroad, superseding, with faster schedule, the steam locomotive and steam schedule, was made on Monday, August 15, on the branch line of the Erie Railroad which runs from Tonawanda to Lockport, N. Y., feeding into the main line of that road. The service is of a mixed type, the passenger traffic being carried on by trolley cars and the freight service by electric locomotives.

The operating company is the Buffalo & Lockport Railway Company, of which Mr. W. Caryl Ely, first vice-president of the American Street-Railway Association, is president, and Burt Van Horn, general manager of the Buffalo & Niagara Electric Railway Company, is manager. C. K. Marshall, superintendent of the Buffalo & Niagara Falls Electric Railway Company, will also be superintendent of the new company.

The Buffalo & Lockport Railway Company was organized in April, 1898, for the purpose of connecting the cities of Buffalo and Lockport, N. Y., by means of a first-class, high-speed electric railway. It has acquired by purchase the road formerly owned by the Lock City Electric Railroad Company, consisting of five and one half miles of first-class single track running through the principal streets of the city of Lockport, with its equipment for local business. It has also acquired by a ninety-nine-year lease the Lockport branch of the Erie Railroad from Lockport to North Tonawanda, N. Y., consisting of 13½ miles of single track from Lockport to North Tonawanda, with side tracks and switches at way-stations and terminals. This road, when a part of the system of the New York, Lake Erie & Western Railroad was operated by four steam locomotives. The schedule gave about eight trains per day between the principal stations, and a much less number for the less important places. Passengers went through from Lockport to North Tonawanda, from which point they reached Buffalo or Niagara Falls.

The Buffalo and Lockport Railway Company has also acquired by purchase the roads formerly owned by the Buffalo, Kenmore & Tonawanda Railway Company, and by the Buffalo, Elmwood Avenue & North Tonawanda Railway Company, consisting of 7½ miles of single track between Buffalo and North Tonawanda, and one mile of

single track within the city of Buffalo. By these tracks it makes connection with the tracks of the Buffalo Railway in the latter city. The total length of the tracks owned or leased by the company is twenty-nine miles.

By traffic contracts with the Buffalo Railway Co. and Buffalo and North Tonawanda Electric Railway this company thus provides a through line from all parts of Lockport to all parts of Buffalo, and also between Lockport and Niagara Falls. It will do all the freight, mail and express business of the Erie Railroad between Lockport and North Tonawanda, and will in many ways become a component part of the Erie system. The cars and trains between Buffalo and Lockport run direct to the main station of the Erie Railroad at North Tonawanda, and the sight of the steam and electric systems side by side at this point, and doing business through the same train-yard, is a novel one.

Work was commenced May 17, 1898, and at midnight on Sunday, August 14, the steam service was suspended. Nothing has since occurred to mar the perfect and punctual operation of the road on the new schedule. It is already doing a heavy business.

Power is obtained from the Niagara Falls Power Company by tapping its long-distance transmission line between Buffalo and Niagara Falls at a point between the Falls power house and the station of the Buffalo & Niagara Falls Electric Railway Co. at Tonawanda. It is carried at a pressure of 10,500 volts alternating current over the No. 0000 bare copper wires on triple petticoated insulators set on cedar poles to the rotary converter substation located in a new power house at the Lockport terminal of the old Erie branch. Here it is led into six 150 K. W. static transformers of the air-blast type, similar in construction and operation to those installed in the Niagara street power house of the Buffalo Street Railway. In these the pressure is reduced to 350 volts, and at this pressure the current passes to two rotary converters, where it is converted into continuous current at 500 volts. The rotary converters are standard General Electric six-pole, 400-K. W., 500-revolution machines. The switchboard is of the standard panel type, and consists of one high-tension panel for the high-poten-

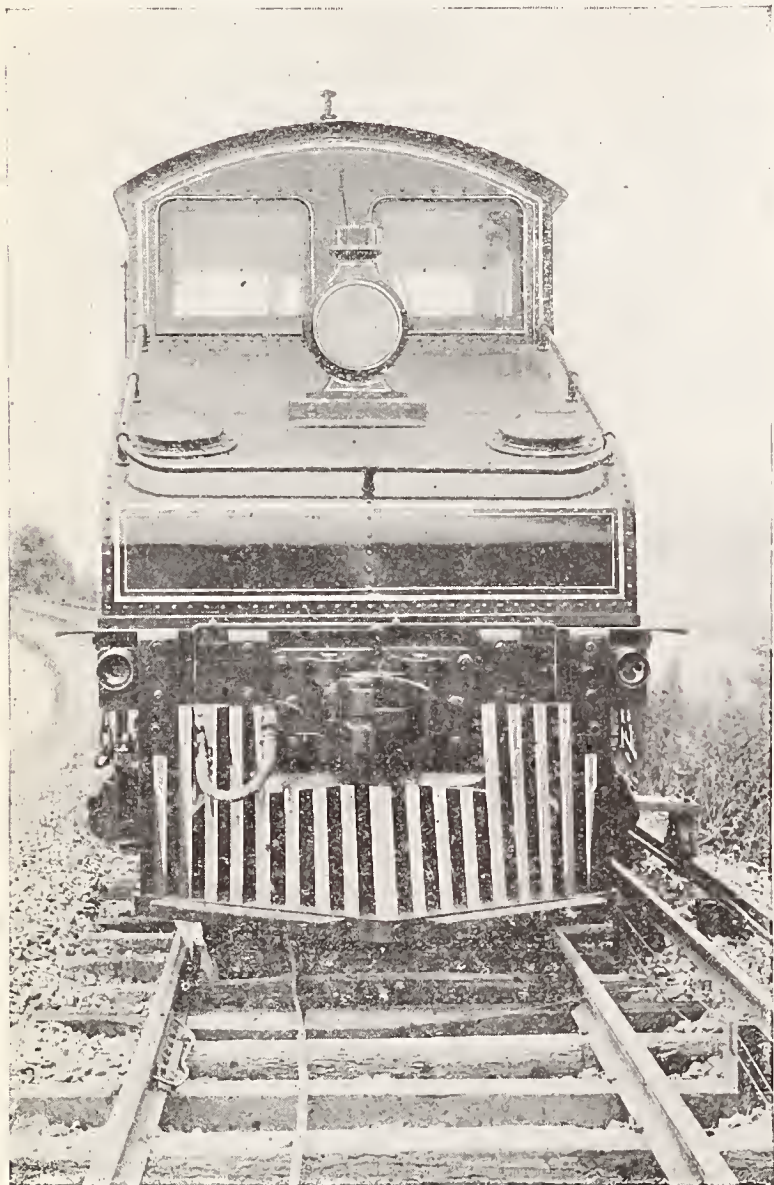
tial transmission, two low-tension panels for the alternating-current side of the rotaries, two "K" direct-current railway panels for the direct-current sides of the rotaries, and two transformer panels. The air blast for the transformers is furnished by a blower built by the Buffalo Forge Company and driven by a 1-2 K. W. motor.

The switches for the high-tension current are of the quick-break type, each blade being separated from its

The Lockport converter station will then feed back seven miles to Lockport and supply current also to the city lines in Lockport itself.

The new rolling stock consists of two 36-ton electric locomotives, supplied by the General Electric Company, for freight service, and ten electric motor cars mounted on eight wheels, and built by the J. G. Brill Company, of Philadelphia, for passenger service.

The theory of handling the passenger service has been entirely changed from that in force with steam traction. Instead of long intervals between trains, the cars are run



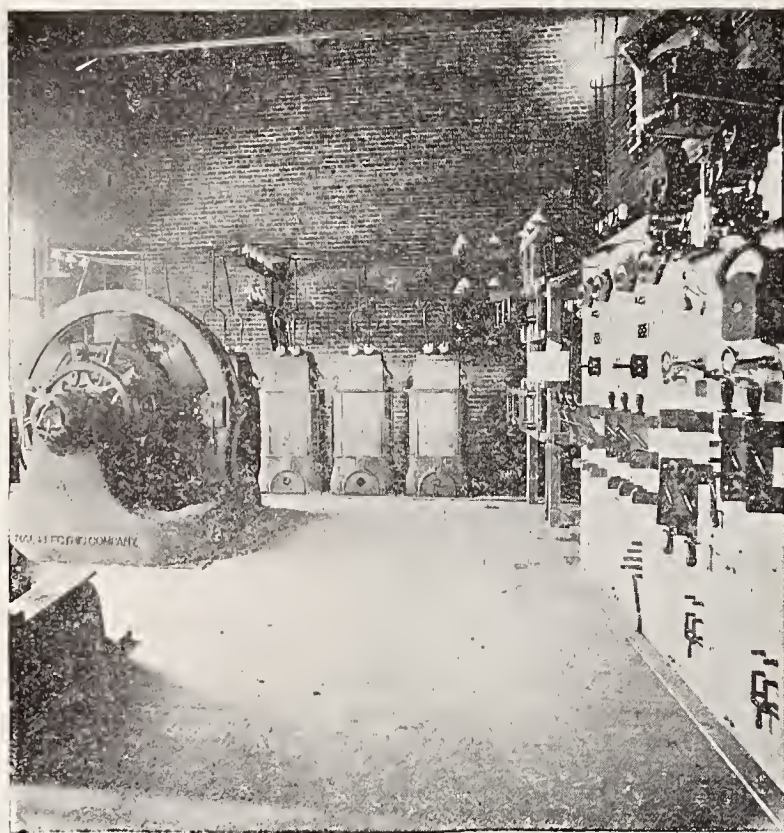
End View of Locomotive under test at Schenectady.

next neighbor by a marble barrier. The blades are pulled open by means of a hooked stick, the hook being inserted in an eyelet into the end of the blade. The fuses on the high-potential circuits are of the expulsion type, in which the fuse is held between two springs, so that at the moment of fusing the two ends, between which the arc would ordinarily spring, are instantaneously pulled apart. Each of the direct-current panels is, of course, equipped with a "K" automatic circuit breaker.

The line is protected by G. E. lightning arresters of the short-gap type, so successfully employed in the high-voltage transmission of the West, as well as on the Niagara transmission circuits. The lightning arresters are placed on the wall of the sub-station, where the high-potential transmission wires enter the building.

As soon as their present plant is completed, another rotary converter sub-station will be erected at Tonawanda, taking current also from Niagara Falls.

From the starting point in Buffalo to the city limits the cars are operated by current from the Buffalo Railway Company's station. The new converter sub-station at Tonawanda will feed seven miles to Lockport and half way in the direction of Niagara Falls, the converters at Niagara Falls feeding half way back to Tonawanda. The arrangement will be such that the Buffalo & Lockport Railway system can give current to, or take it from, the system of the Buffalo & Niagara Falls Electric Railway,



Interior, Sub-station, Lockport, showing Air Blast, Transformers, Rotary Converters and Switchboard.

on half-hour headway. This requires five cars to operate the twenty-five miles between Lockport and Buffalo. The speed is high. Over their own right of way the cars ran on their first trip at the rate of fifty miles per hour, including stops. The running time from Lockport to Tonawanda is twenty-six minutes; to Buffalo, one hour and fifteen minutes. In this trip thirty three minutes are spent in the city of Buffalo in a distance of six miles, where the speed has to be kept low to conform to city ordinances. Even with this drawback, however, it is expected that in the near future the running time between Buffalo and Lockport will be reduced to one hour.

The passenger and smoking combination cars are 31 ft. 8 in. long over the end panels, and with platforms 4 ft. 6 in. long, measure 42 ft. 4 in. over the buffers. The platforms are enclosed by round-end vestibules, with openings on the diagonally opposite corners of the cars. Hinged doors, which fold back against the vestibules, completely enclose the platforms when desired. Folding gates are also provided, turning back against the outside of the vestibule. The car is divided into two compartments, one of which is used for smokers and is separated from the remainder of the car by a partition having glass windows on each side of the sliding door. All the seats have spring cushions. The inside finish of the car is cherry, with chipped glass beveled edges in the ventilators. The cars are also fitted with electric heaters, a small one under each seat, and also push buttons. All the cars of the road are mounted on Perfect trucks.

These cars are run on "T"-rails at a speed that will enable them to average forty-five or fifty miles per hour. Electric brakes are provided upon each axle, the disks being cast upon the wheels themselves.

The baggage and passenger combination cars are especially adapted to high-speed service. They have a

passenger compartment, with a seating capacity of twenty-eight, and a baggage compartment. The car body is 31 ft. 8 in. long over the end panels, 7 ft. 8 in. wide at the sills, and 8 ft. wide at the widest point. The platforms are 4 ft. 6 in. long. The total length over the angle-iron buffers is 37 ft. 10 in. Cars and trucks are from the shops of the Brill Co., Philadelphia.

Each car is equipped with four G. E.-57 (52 H. P.) motors and B-8 controllers. The equipment is similar to that on the new cars used on the long-distance lines of the North Jersey Street Railway Company, of Newark, N. J. The weight of each car loaded is from twenty to twenty-five tons.

The two locomotives have been built for the purpose of handling the freight business of the road exclusively. The road being a feeder to the main Erie system, the freight traffic is considerable. To haul it, therefore, powerful locomotives were necessary, and in them the General Electric Company, which alone has had any experience in building large electric locomotives, has incorporated such improvements as the actual operation of its locomotives on the Baltimore & Ohio Railroad, the New York, New Haven & Hartford R. R. and the Hoboken Shore Road has dictated.

The design follows closely that of the locomotives just mentioned, two sloping shields being placed one on each side of a central cab, the whole carried on two swiveled trucks. The cab frame is made of 1 3/4 in. x 1 3/4 in. angles, covered with a sheathing of 1/8 in. iron.

The platform or main frame is built up of 8-in. channels running the entire length of the platform, and securely riveted to cross-plates at the ends directly over the centre truck bearings. Heavy oak buffer beams, to which are attached draw heads and pilots, are secured to the ends of the platform. The trucks have swing bolsters, supported by elliptical springs, and the truck frames are built up of forged and rolled iron securely bolted and riveted together, the pedestals being made of cast steel. The truck proper rests on coil springs, supported by equalizing bars. The wheels are 36 in. in diameter, with steel rims and iron centres.

The locomotives are each equipped with four G. E.-55 motors. The draw-bar pull at full speed is approximately 3,400 lbs., handling a 340-ton train at about fifteen miles per hour. The motors are rated each at about 160 H. P. As the maximum speed required is quite low, two motors are at all times connected in series.

The controller is of the K-24 type, with cut-out wiring modified to fit the special requirements of the equipment in regard to speed. Outside the resistance points only two combinations of the motors are possible—the first throwing all four motors in series, and the second or running position, placing motors No. 1 and No. 3 in series and the pair in multiple with motors No. 2 and No. 4, similarly connected.

The locomotives are equipped with pneumatically controlled trolleys. With this arrangement it is no longer necessary for the engineer or helper to leave the cab to replace the wheel on the wire or reverse the trolley. This is effected by a handle conveniently placed over the engineer's head. The downward motion is obtained by admission of air to a cylinder, the piston of which in moving compresses the spring holding the pole in place when running. The upward motion is accomplished by the spring and the movement sideways by hand, both pole and handle being on a swivel plate. The view of the locomotive in Fig. 2 was taken under test at Schenectady. Here, for convenience, the current was taken from a third rail, and this explains the absence of a trolley pole.

The balance of the equipment consists of air brakes, air whistle, bell, air blast sanding device, air pump, magnetic circuit breaker, magnetic switch, lightning arrester, electric lights, etc.

The following are the principal dimensions :

Length over all.....	32 ft.
Height of cab over rails.....	12 "
Distance between centre of trucks..	13 "
Wheel base (one truck).....	6 "
Gauge,.....	4 " 8 1/2 in.
Diameter of wheels.....	36 in.
Complete weight of locomotive.....	36 tons.

The locomotives have already been subjected to several severe tests. They are specified to be capable of hauling trains of 300 tons weight, exclusive of the locomotive, which, estimating the average car at thirty tons, would mean a train of ten cars. The locomotives have already proved themselves equal to hauling as many as twenty-eight loaded freight cars at the specified speed of fifteen miles an hour.

The transformation of this line from steam to an electrically operated road marks an important step in the employment of current on the steam road. If in its operation it successfully attains the results expected, it will conclusively prove that electricity can be economically applied to the operation of branches and feeders of steam trunk-line systems. It would be too much to expect an immediate conversion of these latter main lines from steam operation to operation by electricity, but with electric locomotives and motor cars profitably carrying on both freight and passenger traffic on their feeders, the entering wedge will be driven still further and the ultimate result will be by so much nearer of attainment.

Considerable satisfaction has been expressed by the citizens of Lockport at the change in motive-power, and great credit is due Messrs. Caryl Ely and Van Horn for the initiative which has brought about the successful installation of electricity on this road.

THE WILLARD THIRD-RAIL SYSTEM.

The Long Island Railroad Company have allowed Mr. Willard, the originator of the Willard third-rail system, to make a test upon a two-mile length of track, its object being to show the practical utility of the system he has developed and its superiority to those now in vogue. Mr. Willard has spent a great deal of time in perfecting the details of this system and now feels that the time has approached to give it the roughest kinds of handling. Street-railway men look forward to the results of this test with great curiosity. It may start an innovation in street-railway practice that will be regarded as distinctly progressive.

See page 169—"Electric Roads in Canada."

TWENTIETH ANNUAL CLAMBAKE OF THE AMERICAN ELECTRICAL WORKS.

The above time-honored institution is annually revived and heralded by a form of invitation reading as follows:

You are invited to be present at the Twentieth Annual Rhode Island Clam Dinner tendered to the Electrical Fraternity by Eugene F. Phillips, general manager of the American Electrical Works, of Providence, R. I., at Pomham Club, on Saturday, September 10, 1898. Lunch at 11:30. Bake opens at 2.

The good fellowship predominant at these picnics leaves a lasting impression upon the participants, making those that are invited regard themselves as among the favored few.

Council Bluffs, Iowa.—Council Bluffs Gas & Electric Light Co. has petitioned for foreclosure of first mortgage and receiver.

THE MINING OF MICA.



OR each known mineral a purpose has been discovered, sometimes making it of immense commercial value. The back-bone of this earth is of granite, and among the elements of its composition may be found a substance of the greatest importance to the electrical world, namely, mica. Mica mining is an ancient industry, and although the demand for mica in the days of ancient Egypt was great enough to call it to the attention of mankind, in these latter

days, thousands of years after, the demand, through the influence of a new and prospering industry, has developed to enormous proportions.

There are mica mines all over the world, yet but few



Plate 1.—Women Carrying Mica from the Mines.

of them produce that quality of mica so valuable for insulating purposes to electrical engineers. The most famous mines in the world are to be found in India, from which are obtained a pure and finely laminated quality of the highest insulating properties and most satisfactory size.

Mr. Franklin Brooks, of Eugene Munsell & Company, 218 Water street, New York City, whose specialty is that

of handling mica for the trade, is one of the few Americans given an opportunity of witnessing the processes through which mica passes, from the mine, with its picturesque surroundings, to the manufacturer of electrical machinery, thousands of miles away. The primitive methods employed for its removal are illustrated in the foregoing reproduced photographs. The name of this mine is the "Abruker," which is 200 feet deep and is operated entirely by native help. Women bear the brunt of labor in removing it from the mine proper.

The discovery of the use of mica for commutator construction was brought about by a long course of practical experiments. There is no known substitute for this material but air, and in consequence every manufacturer of power machinery is forced to use mica. The insulating properties of mica have made it invaluable to the experimentalist, as well as the manufacturer. By its use when a plate is exposed to a powerful alternating electrostatic field dielectric hysteresis is perceptible if the mica has been bathed in paraffine. The specific inductive capacity of mica would make it valuable as a wire insulator in obviating many of the deficiencies of other insulating materials through which electrostatic induction readily occurs. Faraday's remarks in relation to the dielectric and insulating properties of bodies are as follows: "Glass and many bodies which might at first be considered as very fit * * * proved exceedingly unfit. Glass, principally in consequence of the alkali it contained, however well warmed and dried it may be, has a certain degree of conducting power upon its surface, dependent



Plate 2.
Cutting. Cleaning. Packing.

upon the moisture of the atmosphere." Faraday does not state anything disparaging about mica, and universal practice has shown that it stands unique among known minerals in its valuable service to electrical workers.

"The Mineral Resources of the United States," edited by David T. Day, chief of division of mining statistics and technology, which book is issued by the Department of the Interior and the U. S. Geological Survey, contains the following statement, which certainly gives great credit to Eugene Munsell & Company: "Mica is used in the manufacture of paints, wall papers, etc. Ground mica is used extensively in making lubricators and is mixed with cement. Small sheet mica is used in the manufacture of micanite for insulating purposes." It is

evident that the manufacture of micanite by the above concern has been recognized in the literature of the U. S. Government; this, as well as micanite cloth and paper and sheets of the finest mica in the world, covers in general the list of their well-known specialties.

THE SEVENTEENTH ANNUAL MEETING OF THE AMERICAN STREET-RAILWAY ASSOCIATION HELD AT THE MASSACHUSETTS CHARITABLE MECHANIC ASSOCIATION HALL, SEPTEMBER 6-9, 1898.

President Lang, of Toledo, Ohio, called the meeting to order at eleven o'clock, a. m. and said:

the first knowledge on the part of primitive men to commence some form of transportation. Civilization begins when man acquires a power of transporting himself and of transporting goods, and civilization progresses as the command of mankind over the forces of transportation, beginning with transportation in its most primitive form, increases and grows.

One great revolution occurred when mankind learned how to handle the forces of steam, and how to apply it to the great work of moving passengers and moving freights. But just as steam transportation had nearly reached its limit, just about as the means of steam transportation had been practically perfected, this new force of electricity makes its advent upon the scene, and it, too, is harnessed in its performance of the work of civilization; and instead of becoming directly, at any rate, a rival of



Plate 3.—Bringing Raw Material From Mine.



Plate 5.—Mine Owner's Bungalow.

Ladies and Gentlemen: I have the pleasure of introducing to you Mayor Josiah Quincy, of Boston, who will deliver an address of welcome.

Mayor Quincy.

Mr. President and Gentlemen of the American Street-Railway Association: It gives me great pleasure to welcome you to the city, and to express the hope that the deliberations of this large meeting of the American Street-Railway Association may be both pleasant and profitable. The size of this gathering, the wide extent of the representation in this convention, the financial magnitude of the interests involved, affords a striking illustration of the rapid development which is taking place in the electric transportation interests of the United States. They have today won a position as one of the most important—greatest—as one of the interests of the country. Civilization really may be said to have had its inception with

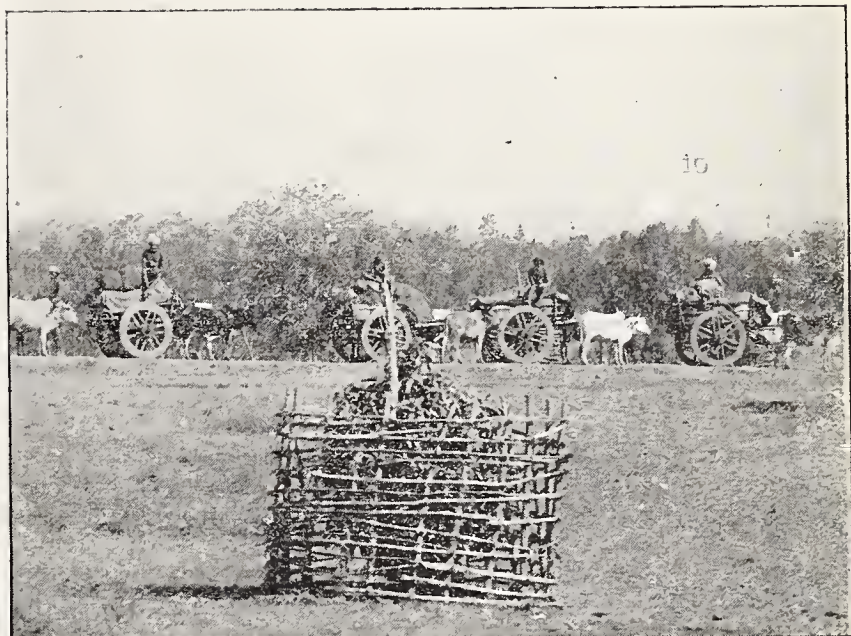


Plate 4.—Taking Finished Product to Railroad.

steam, this comparatively new force of electricity finds its application, so far as transportation is concerned, upon different lines. While these lines may hereafter extend, making electricity directly a rival of steam for many of the purposes for which steam is used, up to the present time steam and electricity have divided between them two somewhat different fields of transportation; and electricity has not yet displaced steam but has filled in a vacant part of the field. It has added to the facilities of transportation which the human race has possessed, and it has supplemented in a most important respect the working of steam, which is primarily applied to transportation over long distances, to the connecting together of states and cities at a distance from each other; it has supplemented that work by the only less important work of developing the intermunicipal and infra-municipal means of communication, and I think the economic

and social results which are to follow from the development of the electrical street railway are only second in importance to those which have followed from those of the development of the steam railroad. I think the street railway has progressed far enough in its evolution, although it has by no means filled its full field in this country, or reached the limit of its usefulness, it has progressed far enough to enable us to see that it is an important agency in the promotion of civilization.

I am confident that this street railway convention, the largest and most important, I believe, which has been held up to the present time, with its mechanical and electrical exhibits and with the important matters which are to come before it for consideration, will accomplish something for the still farther progress of this great interest and this great industry. The people of Boston are always glad to welcome these national conventions. Boston has a great electric street railway system. Not only has she one of the very greatest and, I believe, one of the very best street railroad transportation systems to be found anywhere in the world, but we have in the suburbs of Boston, in that chain of cities and towns which encircle Boston proper, which constitute Greater Boston, embracing, as it does, a million people or more within its limits, we have in these outlying cities and towns, as well, highly developed systems of suburban and inter-suburban street railway transportation. I am sure, therefore, that this Association could not have selected a better centre in which to hold its gatherings this year, in which to take account of the progress that has been made in electric street railway work during the last year, and in looking forward to the progress that is still to be made, than in this city of Boston. I can only wish that your visit may be pleasant as well as profitable, and I can only say in conclusion that if there is anything that the city of Boston, as a corporation, or the citizens of Boston individually can do to make your stay here a pleasant one, I am sure that it will be very cheerfully done. I trust, in your deliberations of the progress of the interests with which you are associated, you will find, as I know you will find, that substantial and material progress in the development of this great interest has been made during the past year; and that you will be able to see before you in the new period of prosperity which, we all believe, awaits this country during the next few years large returns in your street railway business and an inducement for the application of still further capital and still further enterprise for the still greater and more extensive development of this beneficent agency of civilization. [Applause.]

Address of President Albion E. Lang.

The American Street Railway Association. Gentlemen: We are today, for the seventeenth consecutive year, assembled in furtherance of the objects of our Association, under conditions most favorable to a pleasant and profitable meeting; for we are in the house of our father, the city of our birth.

As the presiding officer of the Association, and in the name of the street railway men of Boston, I bid you a hearty, sincere and joyous welcome.

Amid the circumstances of this meeting, our thoughts naturally turn to the time, the persons and the conditions existing when the Association was formed. Some then present are with us to-day, and, whether residents of Boston or not, certainly experience a pardonable pride in the growth and achievements of the Association, as shown by its published proceedings and emphasized by the large number in attendance.

Of the Boston people who were present at the outset, Calvin A. Richards, president of the Metropolitan Railroad Company, now a part of the Boston Elevated system, was a conspicuous and active member. In 1884 he was elected president of the Association, and those who knew him best feel a deep grief that death has robbed us of a member whose welcome, if present, would know no bounds.

As I trace the history of our Association from its inception, I am convinced that its founders, in the words of Emerson, "builded better than they knew," for is it not remarkable that they should have chosen a name and set forth in our Constitution the objects of the Association so wisely and well that no material change has been required to adapt them to present conditions, which are so radically different from those then prevailing?

The Constitution, then as now, says: "The object of this Association shall be the acquisition of experimental, statistical and scientific knowledge relating to the construction, equipment and operation of street railways," etc.

The need for experimental knowledge in connection with a mule goes without saying, and statistical and scientific knowledge with reference to harness, cars or strap-rails sounds very ancient as compared with engines, boilers, generators, girder rails, vestibuled cars, lightning arresters, ohms, volts, watts, amperes, etc., etc., the familiar subjects of to-day. I do not mean, however, to belittle the value of the investigation, discussion and association of the earlier days, because there are too many veterans present (and I might myself be called one) who can testify to the great benefit derived therefrom.

Having laid in this city the foundation of the splendid structure we have since reared, it is very proper that we should return and dwell therein for a few days. Everything gives promise of this being the largest meeting in our existence. If we do not make it one of the most valuable, the fault will be with ourselves. Let us hope to leave such an impression that the Boston people will say: "It was good to have them with us."

In the growth and development of our Association and the business we represent, let us not forget the priceless and unrivaled assistance rendered by the technical press. Without a spokesman, a guardian ever faithful to our interests as they have been, our progress would have been much slower and our pathway exceedingly rough.

Nor must we for a moment forget (if we could) the indefatigable supply man, for he is the noblest Roman of them all. It is his courage, foresight, and energy in taking up the new and useful article, and pressing it upon our attention, that helps to effect economies. We may sometimes be prematurely persuaded, but that is not the fault of the supply man; it is simply one of the arts of his trade necessary for us to learn. But seriously, without them the meetings of our Association would be materially weakened and lose much of their interest and value. Let us, then, not fail to give them and their exhibits all the attention and examination time will permit.

I desire to call attention to our fellow-workers and associates, the Accountants' Association, which hold their meetings simultaneously with ours each year, and are even now in session in another part of the building. The whole business of the street railway revolves around the accountants' office, and many of us can attest the value of having efficient persons in charge thereof. It is with the hope of enabling them to make their services more valuable to their respective companies that the Association was formed; hence they should receive every assistance it is possible for us to render. I bespeak for them your cordial co-operation.

In closing, I wish to thank our efficient secretary and the executive committee for their cordial aid and support during the year, and to assure the members of the Association of my great appreciation of the honor of being called a year ago to the office of president.

Respectfully submitted,

ALBION E. LANG.

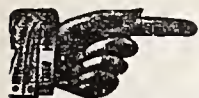
The following gentlemen were nominated and elected by the American Street-Railway Association: for president, Charles S. Sergeant, the second vice-president of the Boston Elevated Railway Company, Boston, Mass.; for first vice-president, Henry C. Moore, president, Trenton Street Railway Company, Trenton, N. J.; for second vice-president, Ernest Woodruff, president At-

The Electrical Age.

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AMERICAN RAILWAY TRUCKS AND APPLIANCES IN FOREIGN COUNTRIES.

The competition with American manufacturers in foreign countries has become keen within the last five years, and particularly so in connection with electric railway appliances. The consuls representing American interests abroad have repeatedly made mention of the change of the tide, through which it seems likely that American enterprise and ingenuity will overcome the prejudices of our friends abroad to an extent sufficient to demonstrate the fact that price and quality render their goods superior. The British Government already believes in the immense advantages possessed both in skill and speed of large electric corporations supplying street-railway cars, and all that is required for their operation, over their own home manufacturers. One of the most characteristic traits of the electrical manufacturer of street railway as well as other supplies is the surprising celerity with which he turns out his machinery.

In the rating of intellects the solution of a problem is not more important than the time taken by each competitor respectively to offer a solution. In the manufacture of electrical machines and appliances the quality of the workmanship is in certain respects second to the question of time required for its production. The accepted superiority of American street-railway motors, controllers, cars and their accessories, to those made either in Germany, France or England, brings competition down to a question of the time of delivery. The tremendous headway that has been made in the United States in the field of street-railway work naturally predisposes a customer, whether foreign or otherwise, to regard our manufacturers as the best informed in the world on the subject of street railways. Therefore the introduction of American appa-

ratus in Belgium, England, South America, Canada and even Germany and France, may be traced directly to a superior quality in design and workmanship and to a ready transportation of goods. Our latest reports indicate a growing trade with China in steel rails. This is, indeed, interesting, because it is but a question of time before Japan and China will be trolleyfied to the same extent as all the metropolitan centres in our own country.

THE STREET-RAILWAY CONVENTIONS.

Two important street-railway conventions have recently taken place. One was composed of a meeting of street-railway men from all over the United States; the other, composed mainly of delegates from New York State. The first met at Boston; the second, at Manhattan Beach. The interests represented at the first and larger convention amounted to untold millions in the line of street-railway properties. The New York State convention, though not composing as great a gathering, is still a very powerful organization. Some of its best friends and hardest workers come from Binghamton. The nature of the papers and discussions carried on at these conventions made them exceedingly valuable and very interesting to proprietors, general managers and superintendents of street-railways. No better proof could be brought forward showing an intense desire on the part of street-railway men to make rapid progress than this annual co-operation of interests and exchange of information. The general public are immediately benefited by such conventions because, taking it all in all, the object of such meetings is that of bringing about a general improvement in the systems employed. This unselfish object is certainly of benefit to those that ride in electric cars and support the huge corporations with their multitudinous nickels. The State tax upon each of these roads in itself provides our government with a very considerable annuity. These conventions, therefore, become of national importance when viewed in connection with the revenue they produce as well as convenience afforded to bread-winners.

TELEGRAPHING WITHOUT WIRES IN BELGIUM.

At Liege, Belgium, experiments have been conducted in wireless telegraphy by Dr. De La Riccia, an exponent of the Montifiore Institute of Electricity. Riccia has followed out experimentally the theory of resonance, without adherence to which idea wireless telegraphy is not truly practical. Electrical resonance is obtained by adjusting the capacity, self-induction and resistance of one circuit so that it will respond to the combined influence of these three factors in another. In other words, one circuit is electrically tuned so as to be in touch with any other properly adjusted. In practice it is exceedingly difficult to create this electrical harmony. Yet the reader can deal with the following quotation as he sees fit: "Dr. Riccia has made improvements in apparatus already in use, simplifying it and increasing its power, and claims that he can confine the oscillations of the transmitter to any special point, to the exclusion of all others. In case of communication between war vessels or ports, the message could be transmitted to one alone; in case of fog at sea, the oscillations would not be limited. Dr. Riccia, it is said, can make the presence of a vessel known to another at a distance of thirty miles, and telegraph real messages seven miles. The full text of the report has been transmitted to the War Department."

A system possessing selective power is one we have been looking for, and its successful outcome is one which will heap great credit upon earlier experimenters, such as Hertz, Helmholtz, Tesla and Pupin. A telephone system dispensing with wires may be the next invention to expect. A telephone outfit resonant to another would be the means of floating the mightiest corporation the world has ever beheld.

lanta Consolidated Street Railway Company, Atlanta, Ga.; third vice-president, Walton H. Holmes, general manager Kansas City Railway Company, Kansas City, Mo.; for secretary and treasurer, Thos. C. Penington, treasurer, Chicago City Railway Company, Chicago, Ill.; The executive committee: Albion E. Lang, president of the Toledo Traction Company, Toledo, O.; George E. Yuill, second vice-president of the West Chicago Street-Railway Company, Chicago; Frank Jones, president of the Memphis Street Railway Company, Memphis, Tenn.; John I. Beggs, general manager Milwaukee Railway & Light Company, Milwaukee, Wis.; Ira McCormick, general superintendent, Brooklyn Heights Railroad Company, Brooklyn, N. Y. It was moved and seconded:

That the next meeting of the Association be held in Chicago, Ill., provided that facilities satisfactory to the executive committee, in the way of a proper hall for exhibition and convention purposes, shall be provided without expense to the American Street-Railway Association.

Installation address of President-Elect Sergeant:

President Sergeant: Gentlemen and Members of the American Street-Railway Association: I wish to thank you most heartily for my most sudden elevation to office. I feel proud to be permitted to serve you for the coming year. I cannot hope, perhaps, to give as good an administration as my immediate predecessor, Mr. Lang, whose efforts in behalf of the association I am sure you all appreciate, and the success which has crowned these efforts, and the long line of past presidents, is one which fills the mind of a new incumbent with some embarrassment, based on the idea that there is a standard which must be upheld.

As to this association, I feel strongly that it has a great work to do, that its meetings are not merely a pleasant vacation, that it is not called together merely for the purpose of reading and discussing the papers, but I believe in the complex relations which are continually coming forward as between the communities and the municipalities and the State governments and the street railways, that much is to be gained by concerted action.

Certainly in Massachusetts we have benefitted very greatly from the fact that our street railways have pulled together for what they knew was right, and they have succeeded, after a struggle covering many years, in obtaining a settlement which, I suppose, looked at from all sides, could be called a fair settlement of the relations of the street railways and the community. I hope that the trial which is being made here of this new plan by which the oppressors of the street railways in a great many communities have been shown by an act of the Legislature how far the street railways are liable to perform work which is not in the line of street railway practice, and by which the street railways themselves are compelled to pay a portion of their receipts for the benefit of the highways—it seems to me that all this work which has been done here is instructive, and is the beginning of a proper recognition of our industry over the whole country.

I assure you, gentlemen, when I first went into the street railway business, particularly in the operating department, I was perfectly appalled; it seemed to me I was in an unlawful business, and everybody was down on the street railway, for it was hampered and troubled by one requirement and exaction after another, and when we made complaints the answer to it all was: "You are in the public streets; you encumber the streets, and you must pay for it."

How much better it is to know what we have to pay for than it is to be put to such payment that may devolve upon us in the judgment of some subordinate road department official in some municipality. I think in such ways as that, and in this matter which was taken up the other day, of the mail service, simply in having our case presented in order to get proper recognition, the associa-

tion has a field perhaps greater than any it has yet filled, and I can only say in closing that so far as it lies in my power to further the work of the Association and benefit the interests of street railways, I shall certainly do so. I thank you very much, gentlemen, for the honor.

Ex-President Lang then answered: I now declare the newly elected officers to be duly installed and take pleasure in handing to the new presiding officer the gavel with my best wishes. [Applause.]

President Sergeant: I believe that the Constitution of our Association provides that the newly elected officers shall enter upon their duties after the annual meeting is adjourned. And as it seems almost as if some duties were about to be forced upon me, I suppose for that reason a motion to adjourn would be in order.

Mr. Goff, of Fall River, rose: I move you, Mr. President, that we now adjourn to meet in Chicago in 1899. The convention dispersed accordingly until a year hence.

EXHIBITORS AND ATTENDANTS AT THE SIXTEENTH ANNUAL CONVENTION OF THE STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK, AT MANHATTAN BEACH, SEPT. 13-14, 1898.

THE BIBBER-WHITE COMPANY, 49 Federal street, Boston, had on exhibition a complete line of their railway supplies, in charge of Mr. Herbert W. Smith, the manager of their railway department. The souvenirs they distributed, in the shape of a miniature trolley pole, made of aluminum, and the trolley wheel represented by a circular rubber eraser, caught the fancy of the delegates immediately and were in great demand among all.

F. H. NEWCOMB, 136 Flatbush avenue, Brooklyn, N. Y., showed a complete line of his well known uniform caps, and was ably represented in the person of Joseph Rogers.

THE NEW HAVEN CAR REGISTER COMPANY, New Haven, Conn., showed their famous "New Haven" car registers, known wherever street cars are operated. Messrs. Willis M. Anthony and A. W. Chappell represented the company and kept the attendants of the convention well informed of the merits of the "New Haven" car registers.

THE ROOKE REGISTERING COMPANY, of Peoria, Ill., exhibited the Rooke fare register, patented by George F. Rooke. This device is used for collecting fares on street cars, automatically recording them, and sounding an alarm, and is a great money saver for street railway companies. Mr. A. M. Loper was in charge of the exhibit.

THE CUTTER ELECTRICAL & MANUFACTURING COMPANY, of Philadelphia, were represented by V. C. Gilpin, their New York agent, offices 120 Liberty street. They had on exhibition their well known C-S flush switches and I-T-E automatic magnetic circuit breakers, favorably known for their never-failing accuracy and reliability.

THE DALE COMPANY, of Thames and Greenwich streets, New York, showed their new porcelain multiple receptacle for incandescent lamps. This receptacle is an unequalled car fixture, requiring no insulating joints, bugs, wiring, shade holders, and the many other requirements found in most car fixtures.

WILSON, THOMSON & COMPANY, 313-315 Fulton street, Brooklyn, had the Wilson patent trolley pole catcher on exhibition, which attracted the attention of all the visitors. This novel device catches the pole instantly after the wheel has left the wire, holding

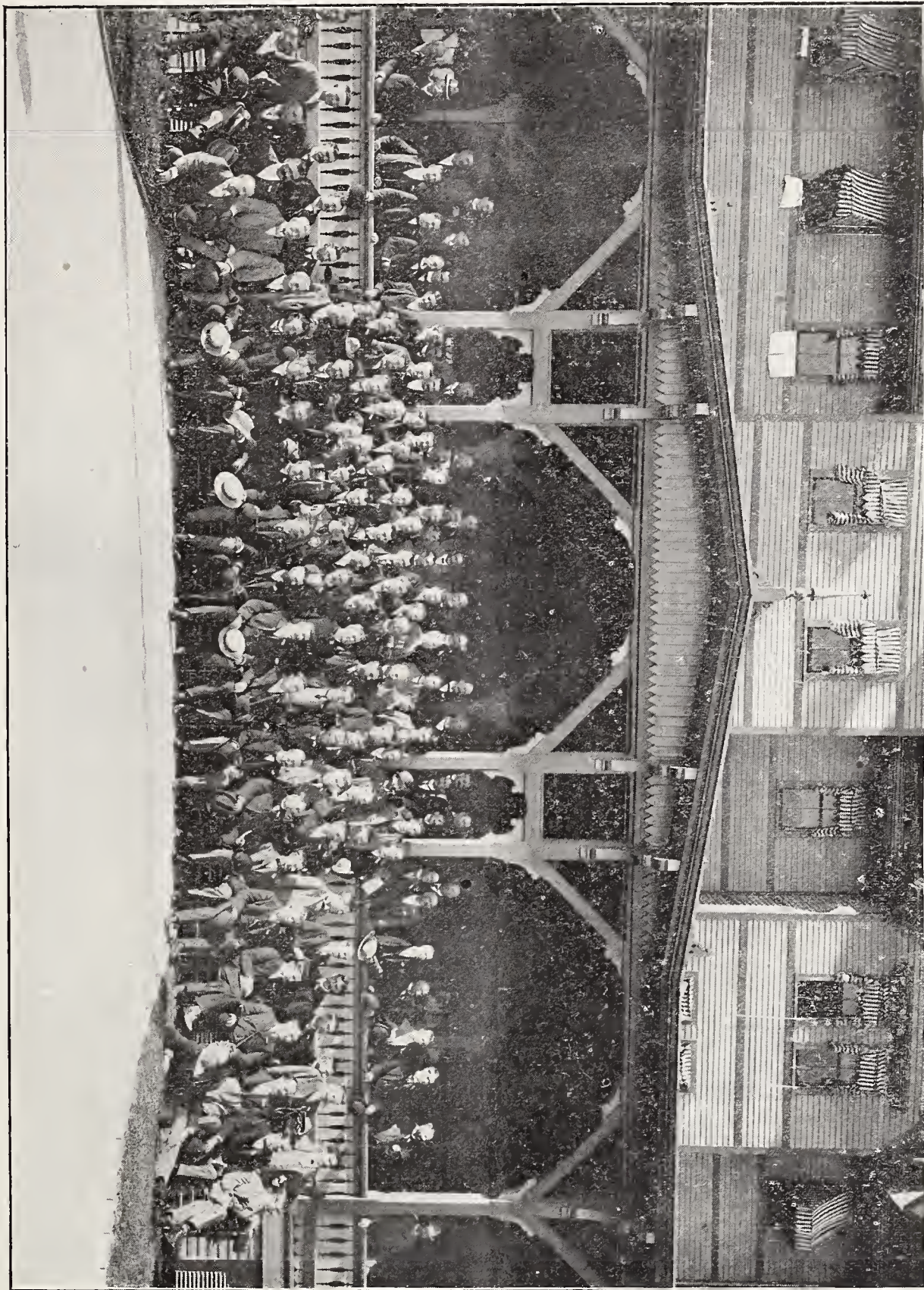
it securely until released by the conductor, and preventing damage to overhead wires. Mr. W. J. Thomson was in attendance, explaining the excellent features of the above-mentioned device.

MESSRS. J. BARKER CARTER, president, and W. O. CLARK, chief engineer, of the Indestructible Road-Bed Construction Company, 81 New street, New York, distributed circulars calling attention to the company's new system of construction of railroad beds.

exhibition samples of their work, the advantages of which were clearly explained by Mr. W. J. Walker.

THE FALK MANUFACTURING COMPANY's exhibit consisted of the automotoneer, which attracted a great deal of interest. Mr. James T. George explained to the delegates how this apparatus saved power, prevented injury to insulation, cut down operating expenses, etc., and how advantageous it was to use the same on all electric street railways.

Members of the New York State Street Railway Association.



GEORGE A. PARMENTIER, Cambridgeport, Mass., had an interesting exhibit of his life guards and track cleaners. A section of the platform of an electric car, with fender attached, was shown, thus affording an excellent opportunity to street railway men to see how this car fender is operated. The fender is meeting with great success wherever introduced, and Mr. Parmentier has received some very flattering testimonials regarding the same.

J. P. SJOBERG & COMPANY, 145-147 11th avenue, New York, manufacturers of street car woodwork, had on

GILES S. ATCHISON, 18 Broadway, New York, representing the St. Louis Register Company, The Hunter Illuminated Car-Sign Company and manager of the Eastern department of street railways of the Hildreth Varnish Company, had an exhibition of the various lines which he represents and welcomed his many friends among the street-railway delegates, with whom he is exceedingly popular.

THE WALKER COMPANY, manufacturers of street-railway apparatus, of Cleveland, O., was well represented in the person of Mr. John D. Moore, 20-22 Broad

street, New York. He was in charge of the Walker exhibit, consisting of various types of street-car controllers, generating apparatus and their various other manufactures used in street-railway installations.

W. PRESTON, 859 Fulton street, Brooklyn, exhibited his mechanical switch, an ingenious device used in railroad work.

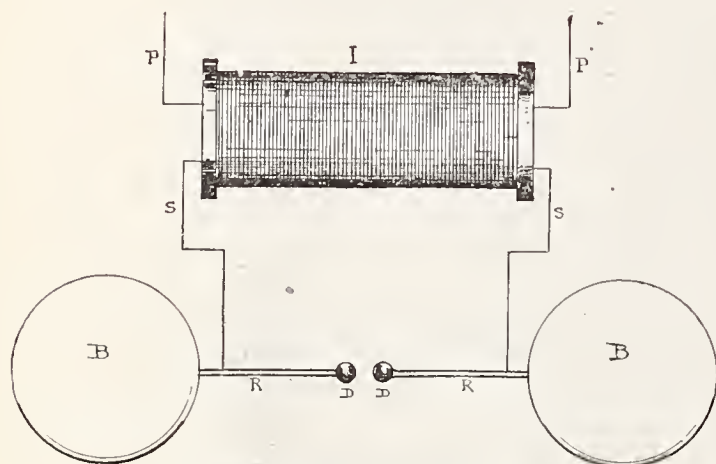
LOUIS E. ROBERT, president of the Catskill Electric Railway Company, was in attendance at the convention, and took a good deal of interest in the various exhibits.

KORAN SUGAHARA, M. E., chief engineer of the Koku Railway Company and the Buso Chuo Railway Company of Tokyo, Japan, imparted an oriental air to the convention and was greatly interested in the work of the Yankee street-railway men.

TESLA AND HERTZ EFFECTS.

The currents of high frequency used by Tesla in his researches are produced by electrical rather than mechanical means. The alternating current dynamo used by him renders a current of 10,000 alternations per second, but the actual current necessary to the performance of the luminous effects has a frequency of millions of oscillations per second, produced by the discharge of Leyden jars or condensers.

Dr. Oliver J. Lodge, in his "Modern Views of Electricity," shows that the discharge of the Leyden jar is in



Hertz Electric Resonator.

general oscillatory; the apparently single and momentary spark, when analyzed in a very rapidly rotating mirror, is shown to consist of a series of alternating flashes, rapidly succeeding one another and lasting individually less than one hundred thousandth of a second. The capacity of the condenser and inertia of the circuit regulate the rapidity of these oscillations. A 1 microfarad condenser discharging through a coil of large self-induction, such as one having an iron core, may oscillate only a few hundred times per second. On the other hand, a Leyden jar of the 1-pint size discharging through a short circuit will set up oscillations, perhaps ten million per second; and a still smaller jar would give oscillations away up in the billions. But these small jars are quickly discharged, and require a constant replenishing.

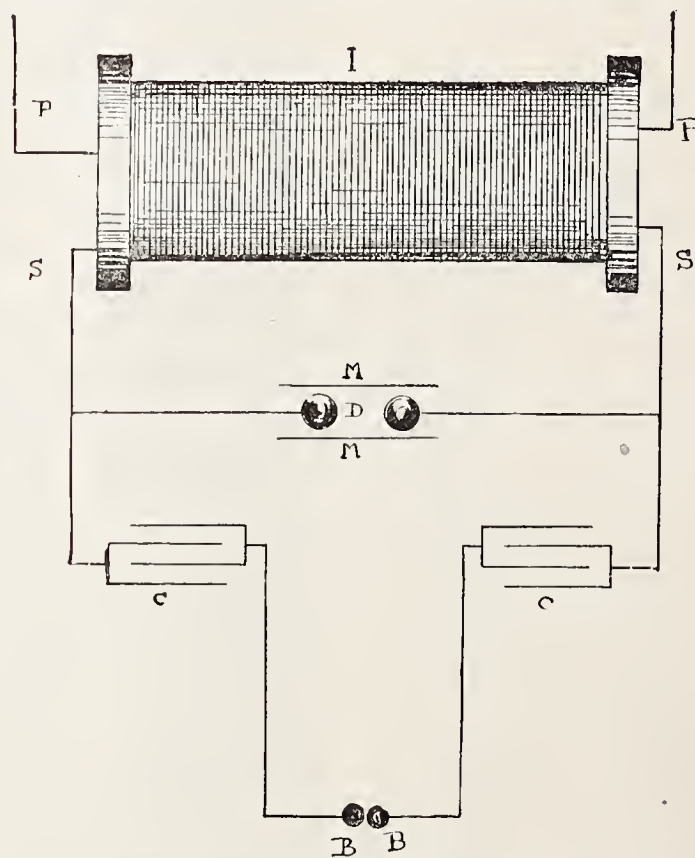
The discharge actually consists of a principal discharge in one direction, and then several reflex actions back and forth, becoming feebler until their cessation. In their vibration they generate waves in the surrounding medium, similar in many respects to sound waves, but of infinitely higher velocity. Their length depends on the rate of vibration of the source and their velocity. The microfarad discharge before mentioned will have a wave length of perhaps 1,200 miles, the small jar not over 70 feet; and yet the true light wave has only an average length of one fifty thousandth of one inch. These waves travel into space until they either die out from exhaus-

tion or are absorbed by some suitable body; but they possess the quality of resonance in a degree like those of sound. Two tuning forks of the same pitch will influence one another—that is, one on being vibrated will start the other in vibration, even at a considerable distance, but the electric waves far surpass them in this respect.

Dr. Hertz made the first practical experiments in this direction with his electric resonator (Fig. 51). This apparatus consisted of a 3-inch spark induction coil, *I*, the secondary wires *S S* being connected to the copper rods *R R*, provided with metal balls *B B*, nearly 11 inches in diameter. The discharging balls *D D* were approximated until a satisfactory discharge passed between them. A large wire ring having a spark gap in its circuit was so influenced by the resonance as to show minute sparks passing across this gap, even when the ring was situated in a distant room. In many experiments with a rapidly vibrating induction coil current, a sparking has been noticed in metallic objects in the same room, in one instance it being discovered in the metallic designs on wall-paper.

The "Tesla" Effects.

In exploring the comparatively new field opened up by Professor Crookes, Nikola Tesla has stimulated research



Tesla Arrangement with a Ruhmkorff Coil.

into the mysteries of high tension and frequency currents and their effects. In the majority of his experiments Tesla uses alternating currents generated by machines of his own design, but in a large number of cases his effects can be duplicated with an induction coil suitably energized. In the latter case the apparatus consists of a battery, a Ruhmkorff coil, two condensers, and a specially constructed induction or disruptive coil, with some few subsidiary implements. The contact-breaker or rheotome must be one giving interruptions of very rapid sequence.

Fig. 52 shows a diagram of the Tesla arrangement with a Ruhmkorff coil. The terminals of the secondary coil of the Ruhmkorff coil *I* terminate at the condensers *C C*. Bridged across the wires before they reach the condensers is the discharger *D*. The second terminals of the condensers are led through the split primary of the disruptive coil, terminating at the points *B B* of the secondary discharger. The secondary of the disruptive coil is either outside or inside the primary coil. The condensers are of special design, being small, but of high insulation. They each consist of two plates of metal a few inches

square immersed in oil and arranged so they can be brought nearer together or further apart, as necessary. Within limits, the smaller these plates are the more frequent will be the oscillations of their discharge. They also fulfil another purpose; they help nullify the high self-induction of the secondary coil by adding capacity to it.

The discharger tips are preferably metal balls under 1 inch in diameter. Tesla uses various forms of dischargers, but for experimental purposes the two metal balls will answer. They are adjusted when the whole apparatus is working according to the results desired. The mica plates serve to establish an air current up through the gap, making the discharge more abrupt, an air blast being also used at times for the furtherance of this object. The device (Fig. 53) consists of an electro-magnet, *C*, set with its poles *P* across the air gap, helping to wipe out the spark, as in a well-known form of lightning arrester. This form, described by Tesla, has the pole pieces *P* shielded by mica plates *M* to prevent the sparks jumping into the magnets. Fig. 53 is an elevation and Fig. 54

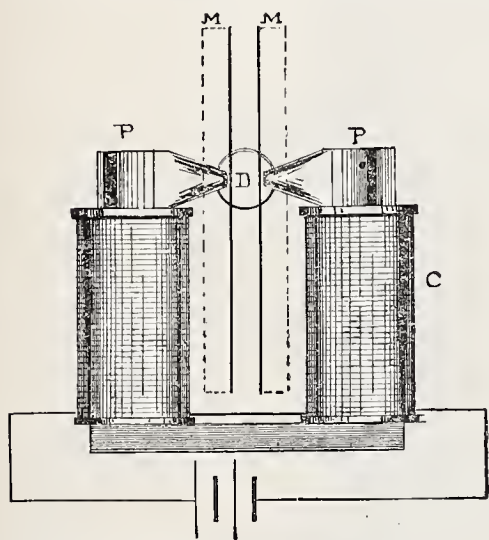


Fig. 53—Tesla's Spark Destroyer.

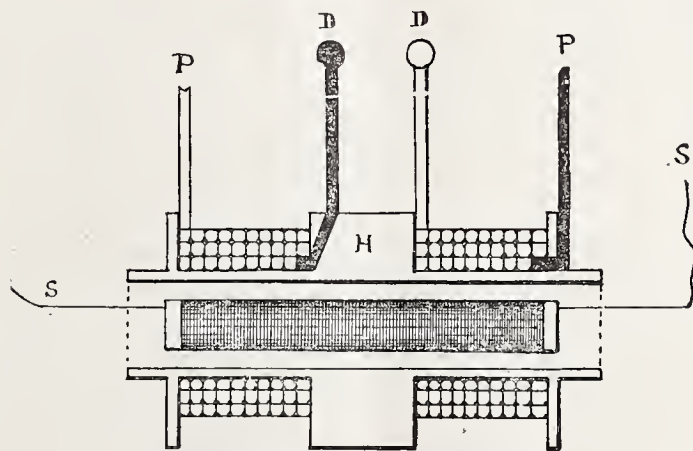
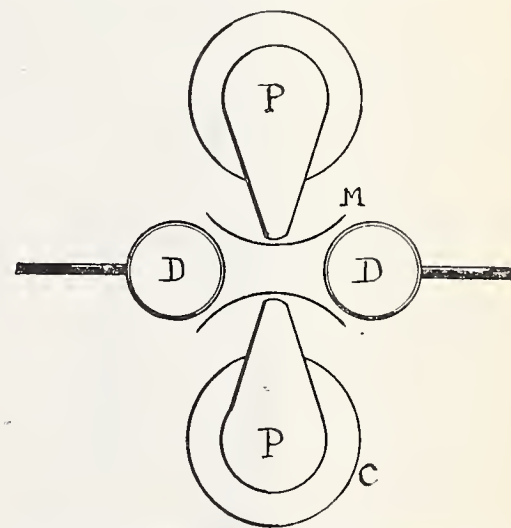


Fig. 55—Disruptive Coil.



Tesla's Spark Destroyer Shielded by Mica Plates, M M.

a plan of this device. The terminals from the condenser are led to the primary of the disruptive coil, or, as in Fig. 52, to two discharger balls *B B*. The disruptive coil (Fig. 55) is easily made, and will give good results with careful handling.

The secondary coil *S* of 300 turns of No. 30 silk-covered magnet wire, wound on a rubber tube or rod $\frac{1}{2}$ inch in diameter, with the ends brought out in glass or rubber tubes. The primary coils are wound on a second rubber tube, *H*, at least 1-10 inch thick, and large enough inside to slip easily over the secondary coil *S*. It must be long enough to project 2 or 3 inches over the ends of the secondary coil turns. The primary has 50 turns in each coil of No. 18 B. & S. gutta-percha covered wire. The four ends, *P P P P*, of this coil are brought out in rubber or glass tubes, two to the condenser and two to the discharger *D D*. Each layer of these coils must be separated by rubber cloth or even cotton cloth. The further apart the layers the less the inductive effect, but the better the insulation. The whole coil is immersed in a glass or wooden vessel containing boiled-out linseed or petroleum oil. A perfect coil should have all the air bubbles drawn out of it after being immersed by putting it under an air-pump, but for many experimental uses this is not absolutely necessary; but extreme care must be taken to insulate the coils and their terminals. This will be apparent when the current is turned on.

The resonance effects obtained during the operation of a Tesla coil are very marked, and their study may lead to the solution of the problems of communication between distant points without the use of other conducting media than the atmosphere. But the main use to which the Tesla currents have been put is that of artificial illumination. These currents have enabled experimenters to ob-

tain a high luminosity in vacua by the aid of only one conducting wire—in fact, in some cases without the utilization of any conductor than the air. An ordinary incandescent lamp connected to one terminal of the coil will show in a fair degree some of the luminescent phenomena. The brush effects from the terminals of the secondary coils are extremely marked and interesting; but to detail the experiments that can be performed with the Tesla disruptive coil would be an impossibility here. Reference is recommended to the published works of Nikola Tesla, which, happily, are readily procurable.

These currents of high frequency have of late been turned to account in electro-therapeutics, principally for the stimulation they exert on the nutritive process. They also exert a very great influence on the vasomotor centres, as is evidenced by the reddening of the skin and exudation of perspiration. This result is readily obtainable by placing the patient in connection with one electrode on an insulating stool, and terminating the other electrode at a large metal plate situated a few feet distant; or the patient may be surrounded by a coil of wire in connection with

the coil of sufficient diameter, however, to prevent contact.—H. S. Norrie, in "Ruhmkorff Induction Coils," by permission of Spon & Chamberlain.

COMBINATION OF THE WALKER AND WESTINGHOUSE INTERESTS.

Two of the largest manufacturing concerns in this country, the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., and the Walker Company, of Cleveland, O., have combined and formed what is probably the largest electrical combination in the world. The Walker Company has been very successful in obtaining large contracts for electric railway installations, but has been greatly hampered by litigation with the Westinghouse Company. The combination, therefore, of the two corporations will result in their working on a more profitable basis than heretofore, unhampered by ruinous competition.

TELEPHONE CALLS.

New Orleans, La.—T. F. Ahern, superintendent People's Telephone Co., is making arrangements for the establishment of a telephone system in New Orleans.

Magnolia, Miss.—The Citizen's Telephone Co. has been granted a franchise by the mayor to build, erect and maintain a local and long-distance telephone system.

Macogdoches, Texas.—Telephone connection with Shreveport, La., will soon be established, the work being pushed as rapidly as possible.

TELEPHONES AND TELEPHONE EQUIPMENTS.

One of the most remarkable industrial developments in this country and abroad is to be found in the manufacture of telephones and telephone equipments. There are thousands of cases on record where the use of the telephone was not even suggested until a full knowledge of its practical utility made a place for it and showed its immediate application.

De Veau & Company, of 27 Rose street, New York City, have covered the field in full and produce, for the trade and individuals, telephone systems and their accessories of a thoroughly modern construction. This concern was organized in 1892 and have added to their reputation ever since as builders of high-class telephone

ceivers and electric bell signal, instead of magneto. The monitor armored set, as well as the armored set just referred to, individually require two cells of batteries for ringing and talking. These 'phones have met with the approval of the trade and consumers to such an extent that the names of certain standard outfits have become by-words. The intercommunicating telephone installed and constructed for any number of stations has proven quite a success in factories, hospitals, large private residences and office buildings. The flexibility of this system and its smoothness of operation have won commendation for it wherever installed. The owners of country villas have found it particularly useful in enabling them to be put in instant communication with any of the outhouses or employees on the premises.

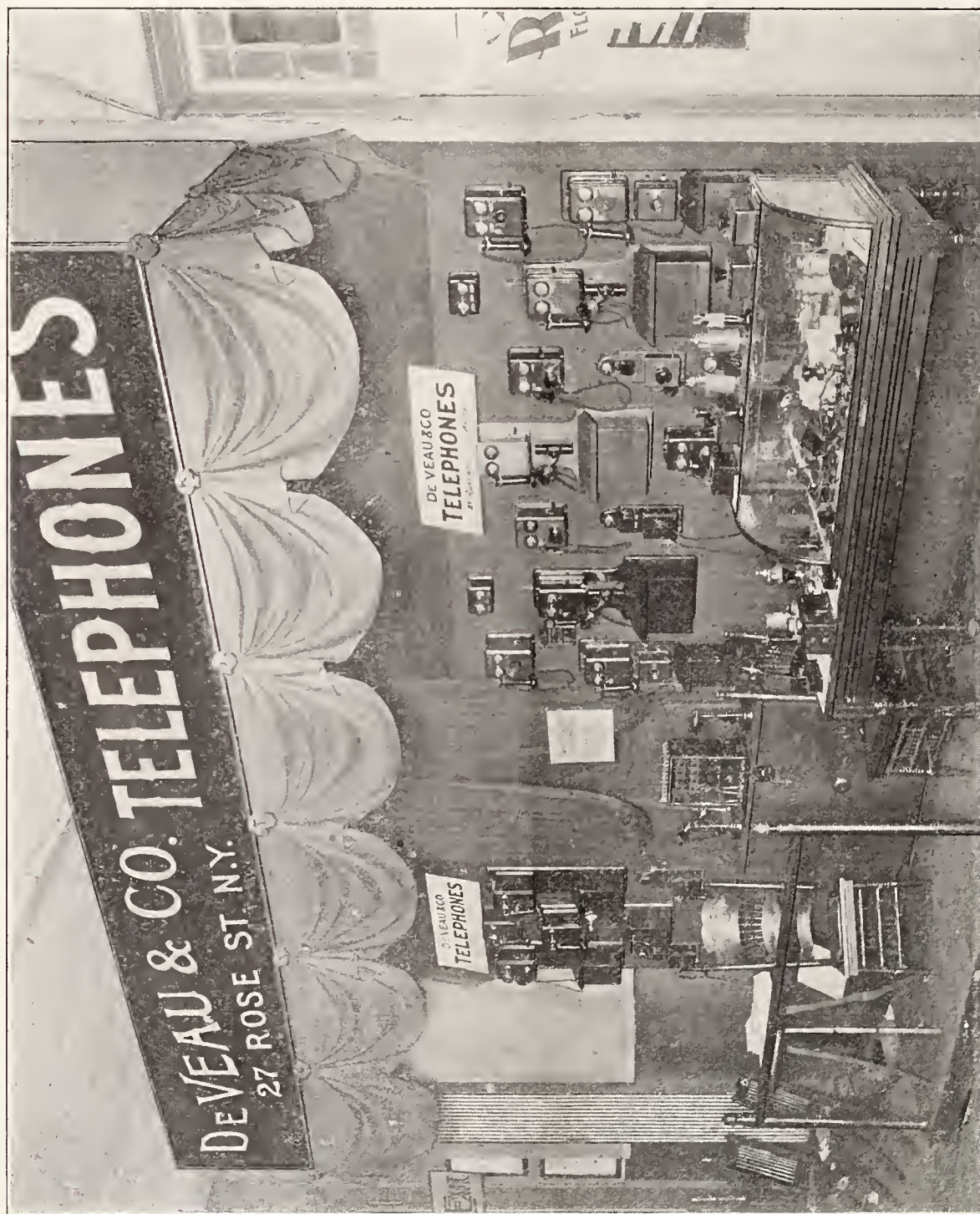


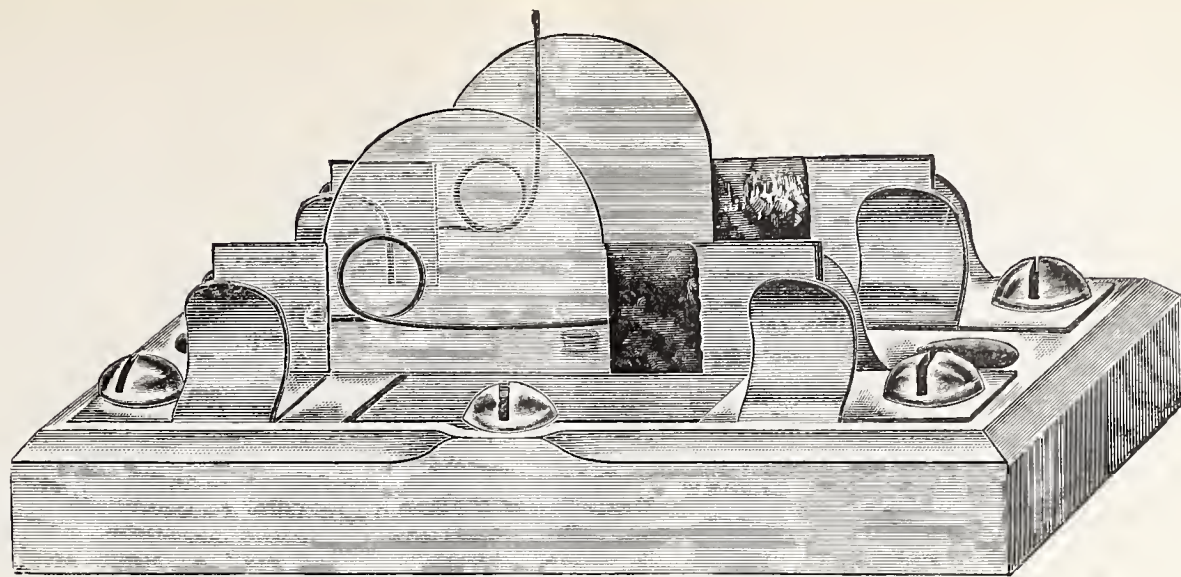
Exhibit of De Veau & Co.—The Latest Telephone and Telephone Appliances.

apparatus. To show the extent of their enterprise we need only refer to the submarine telephone used by the United States Government in connection with the diving costumes supplied to the men of the Light House Board and the United States cruisers and battleships. The portable marine and field telephone outfits for army and navy work have met with great success.

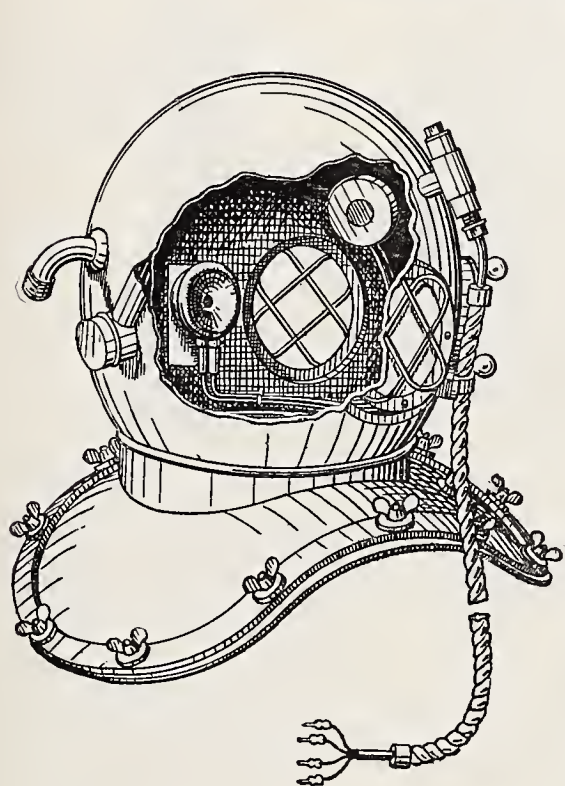
The egg 'phone, illustrated in these columns, is exceedingly convenient where suspension is required from ceiling, wall or gas brackets. It is the smallest and best telephone, as well as the most convenient, in existence, comprising receiver, transmitter, and ringing key. The armored set is so constructed that it represents a most practical telephone outfit, composed of transmitter, re-

The long-lever automatic switch, as well as the self-contained switch, manufactured by De Veau & Company, appeal most strongly to the contractor, its technical value, as well as practical importance, making it indispensable to him when completing a contract that is supposed to be self-contained and to comply in every detail with a liberal form of specification.

The sneak-current lightning arrester, for the purpose of protecting telephone apparatus from sneak currents, lightning or short circuits, is represented for the reader's benefit ready for use. The advantage of this protected device is only appreciated by its absence. In many cases where accidents have occurred, due to the three causes mentioned, and considerable damage caused to telephone



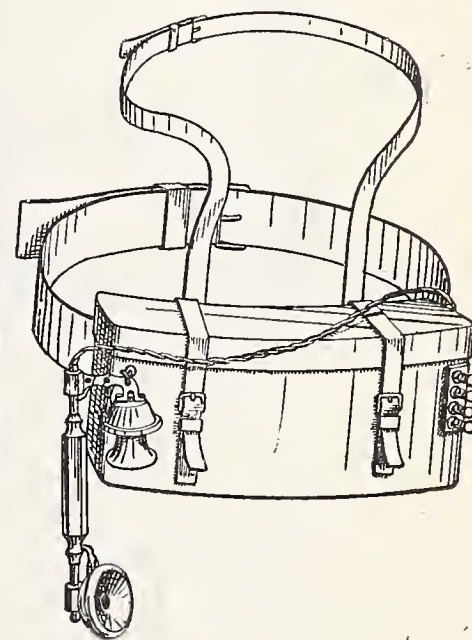
De Veau & Co.'s Sneak-Current Lightning Arrester.



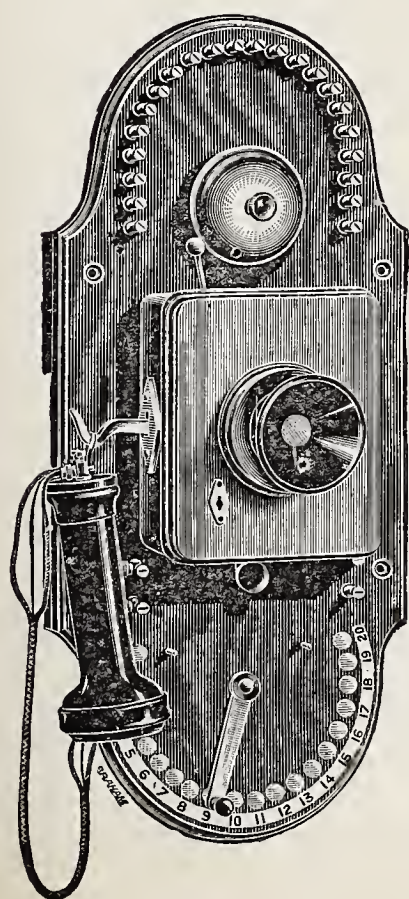
De Veau & Co.'s Submarine Telephone.



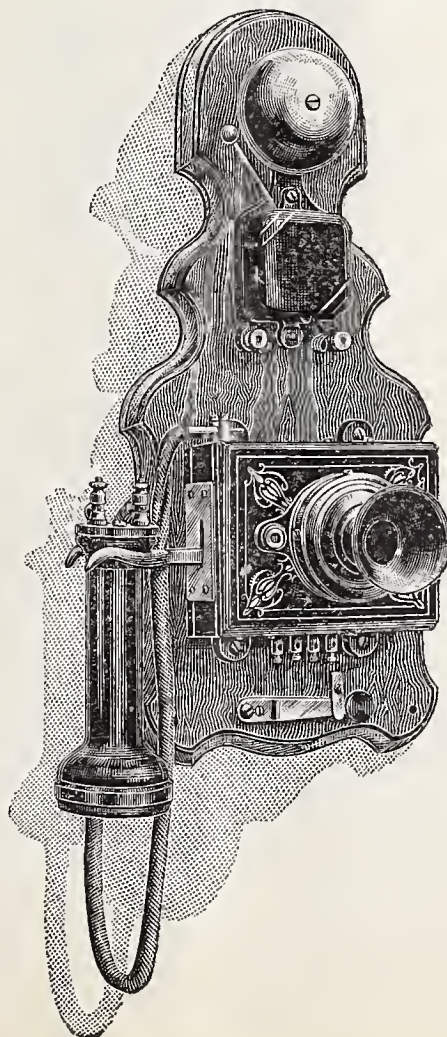
De Veau & Co.'s Egg Telephone.



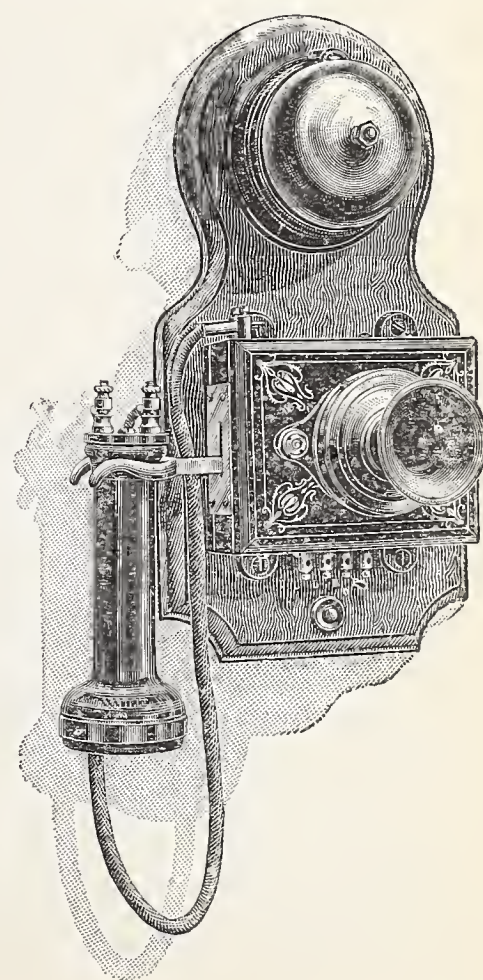
De Veau & Co.'s Submarine Telephone.



De Veau & Co.'s Monitor-Armored Set



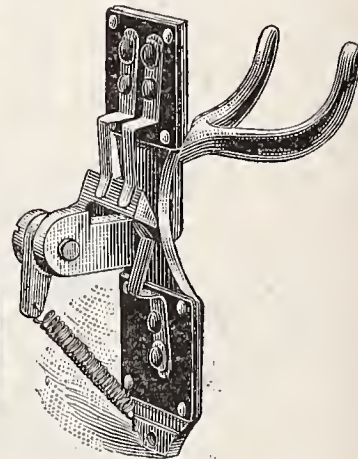
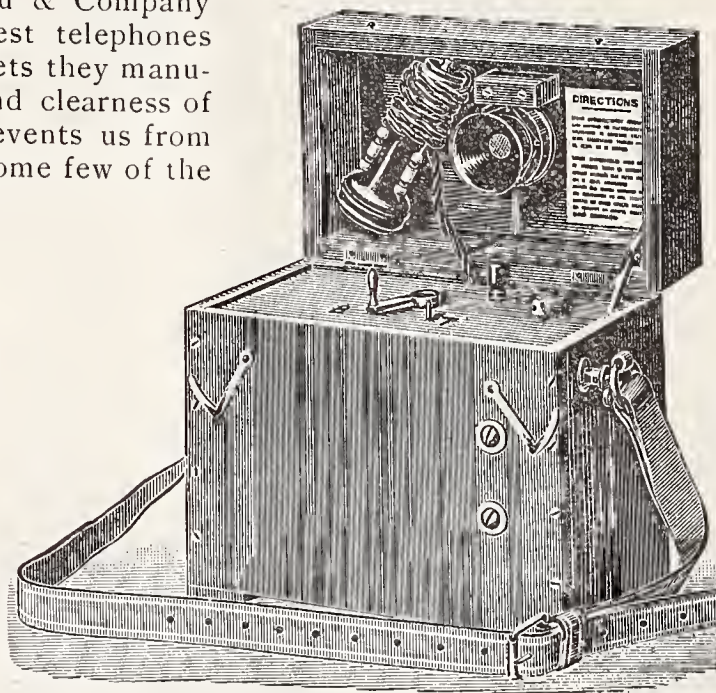
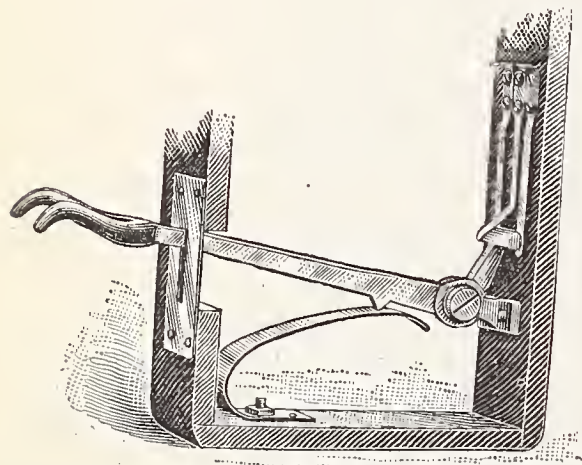
De Veau & Co.'s Intercommunicating Telephone.



De Veau & Co.'s Armored Set.

apparatus, the use of De Veau & Company's sneak-current lightning arrester, by preventing this loss, would have saved much embarrassment in time and money resulting from same.

The fully equipped factory of De Veau & Company enables them to cover the telephone field so completely that customers and contractors are invariably satisfied by calling upon them for the purpose of obtaining durable, handsome and well operating telephonic apparatus. Having kept abreast of the times, De Veau & Company are fully prepared to supply the very latest telephones and telephone equipments. The cabinet sets they manufacture rival all others in design, finish and clearness of tone. The great scope of their work prevents us from making more than a passing reference to some few of the specialties they manufacture.



De Veau & Co.'s Long Lever Automatic Switch. De Veau & Co.'s Portable Marine and Field Telephone. Self-Contained Switch.

THE MANHATTAN PROJECTOR.

The following illustration shows a type of projector or search-light manufactured by the Manhattan General Construction Company, of 111 Broadway, New York City. It is used on sailing craft such as yachts and steamships. From a mechanical standpoint the projector is exceedingly compact, the lamp mechanism being contained below the projector in a box-shaped receptacle. By this means shadows are absent and the light streams forward un-

may be of interest:

Li Hung Chang, the great viceroy of China, said: "Nowhere else in the world are there such fast and luxurious trains" as in America.

Marquis Yamagata, field marshal of the Japanese Empire, said: "The speed, the comfort, the luxury of your railroads, is a marvel to me."

Prince Hilkoﬀ, imperial minister of railroads of Russia, said: "There is nothing in Europe to compare with your railroads."



The Manhattan Projector.

affected. By using horizontally fed carbons which may be moved to any position great convenience is obtained. By the use of English mirrors a vessel a mile distant is clearly distinguished. As the beam can be thrown vertically as well as horizontally, signaling can be carried on in foggy weather.

This substitution of projectors for search-lights means the substitution of a mirror for a silvered coppered parabolic reflector. For naval work, freight and pleasure craft, the projector occupies a very important position, its use in this field of work being almost indispensable and

the adoption of this modern contrivance for advertising purposes incalculable. The projectors are made in japanned iron or polished brass, with copper trimmings, and the eight, fourteen and eighteen-inch sizes in aluminum.

WHAT FOREIGNERS THINK OF OUR RAILWAYS.

What a few foreigners have said of American railways

Sir Henry Truman Wood, special representative of the British government to the world's fair in 1893, said that "nowhere in Europe could there be found such luxury in travel and such excellent service as are given on the railways of the United States."

Paul Leroy Beaulieu, one of the greatest economists of Europe, writes: "The continent of Europe, by the bonds in which it has always held private enterprise, has been able to follow only with a tardy step the example of the United States, which nation has realized in its railroad system three ideal conditions, rapidity, efficiency,

and a good market, while Europe, enveloped in administrative formalism, was destined to attain neither of these three conditions."

ELECTRIC RAILWAYS IN CANADA.

St. Catherines, Ont.—It is believed that the deal for the purchase of the Niagara Central Railway by an American syndicate will be concluded. Messrs. Loss, of Buffalo, and Gibbs, of New York, representatives of the syndicate, were here recently, investigating the outlook of converting the road into an electric system and extending it to Port Dalhousie and Beamsville.

Toronto, Ont.—The Metropolitan Street Railway Co. are considering the extension of their line to Schomberg.

Winnipeg, Man.—A local company has announced its intention to utilize a part of the water power from the Winnipeg River. The project includes the building of an electric railway to extend from the mouth of the Whitemouth River to points on the Winnipeg River.

Lanark, Ont.—The ratepayers of Perth have defeated the Lanark County Electric Railway bonus by-law. There is now a scheme on foot to connect this town with Carleton Place.

Montreal, Que.—The Montreal Street Railway will put down new rails on Craig street.

Nelson, B. C.—C. S. Drummond will apply to the city council for a charter for electric street railways to be built in the towns in this vicinity. Mr. Drummond represents the British Electric Traction Company, of London, England.

Paris, Ont.—A deputation of Toronto gentlemen have approached the Council on the subject of the construction of an electric railway between this town and Ayr. It is understood that a charter has been applied for.

Ottawa, Ont.—The Ottawa Electric Railway Co. intends, it is reported, to extend their line to Britannia. It is also rumored that a bridge will be built across to Aylmer.

Paris, Ont.—A company is seeking a charter under the name of the Grand River Electric Light and Power Co. to construct a stone dam across the river at Mr. Cavan's farm, with the object of supplying light and power. Mr. Fair, of Brantford, is the company's engineer.

CANADIAN ELECTRICAL NEWS.

London, Ont.—An effort is being made to organize a new telephone company. A number of local capitalists are interested.

Brantford, Ont.—The Brantford Electric and Operating Company will expend \$10,000 in putting in a new plant, having received the contract for street lighting for ten years.

St. Thomas, Ont.—The City Council has appointed a committee to report on the question of establishing a municipal electrical plant for street lighting and commercial purposes.

Portage La Prairie, Man.—The Central Electric Light Co. contemplate installing a telephone exchange.

Barrie, Ont.—The Electric Light and Waterworks Committee has reported in favor of installing a municipal lighting plant and recommends that a vote of the ratepayers be taken on a by-law to provide \$35,000 for the purpose.

Halifax, N. S.—The City Electrician has submitted a report to Council showing the probable cost of lighting the city by a municipal plant. The question of installing the same will be considered at an early date.

Ashcroft, B. C.—The Water and Power Co. will erect a power house and install an electric plant.

Ottawa, Ont.—The Ottawa Electric Co. will increase the plant of their No. 2 power house by adding a 60-inch water wheel and a 125-light arc generator.

Winnipeg, Man.—The Western Electrical Company has made a proposition to the city to establish a telephone system.

J. ALCIDE CHAUSSE.

PROPOSED INSTALLATIONS.

Pittsburg, Pa.—The Pennsylvania Tube Works Co. have completed arrangements for the establishment of a \$100,000 electric plant in its great works and the operation of the entire plant by electricity.

Lawrence, Kan.—The newly organized Lawrence Railway Co. will build a system of electric roads to handle passengers, freight and mail.

Thibodeaux, La.—The Mayor may be addressed for information concerning electric light plant.

Chestertown, Md.—Atlee H. Tracy, vice-president and treasurer of the Chestertown Electric Light Co., contemplates the erection of an ice factory with a capacity of ten tons every twenty-four hours.

Kalamazoo, Mich.—The Kalamazoo Valley Electric Co. will develop the water power of the Kalamazoo River at Allegan and will distribute electricity to Allegan, Otsego, Plainwell, Kalamazoo and Battle Creek for light and power.

St. Louis, Mo.—The St. Louis, Fenton and Southwestern Railroad Co. will erect an electric power plant; electricity will be generated by water power.

Somerville, Tenn.—The Mayor may be addressed concerning the issuance of \$10,000 worth of bonds for the construction of water works and erection of electric light plant.

Little Falls, Minn.—County Clerk may be addressed concerning proposed erection of municipal electric light plant.

NEW YORK ITEMS.

MR. NEFF, president of the Bradford Belting Co., one of the largest belt manufacturing concerns in the world and manufacturers of the celebrated "Monarch" insulating paint, is in town at the headquarters of the concern's New York agent, Elmer P. Morris, 15 Cortlandt street.

MR. T. S. SPEER, the genial secretary of the Partridge Carbon Co., of Sandusky, Ohio, was in town this week, on his way home from the American Street-Railway Association meeting in Boston. He also attended the meeting of the New York Street-Railway Association at Manhattan Beach, accompanied by Harry M. Shaw, the New York agent of the Partridge Carbon Co.

MR. ELMER P. MORRIS, of 15 Cortlandt street, was certainly the hero of the Boston Meeting of the American Street-Railway Association. The ladies who attended the meeting will testify to this. His "bow" ideal of a souvenir was the most taking, and taken, thing at the exhibition Hall.

THE AMERICAN IMPULSE WHEEL COMPANY, of 120 Liberty street, note a gratifying demand for their water wheels. They have lately received a large number of orders from the West, where their wheel is meeting with the greatest success.

DE VEAU & COMPANY, 27 Rose street, are working day and night to catch up with their orders for their well-known telephones.

C. L. WARRICK & CO., of 39-41 Cortlandt street, report an encouraging outlook for fall trade and are prepared to fill orders for their well-known "Essex" incandescent lamps, enclosed arc lamps, dynamos and motors. They also install complete plants for electric lighting and power.

FRANCIS GRANGER, Eastern sales agent for the Corning Brake Shoe Company, of Corning, N. Y., with offices at 35 Nassau street, was one of the most popular salesmen at the meetings of the American Street-Railway Association and the New York Street-Railway Association at Boston and Manhattan Beach respectively.

NORMAN McCARTY, representing Hugo Reisinger, 11 Broadway, importer of the celebrated "Electra" Nuernberg Carbons, is one of the successful salesmen and popular men among central-station managers and is receiving some fine orders for "Electra" carbons.

Philip P. Nungesser, of the Nungesser Electric Battery Company, Cleveland, Ohio, was in town lately, and took a number of large orders home with him.

A. L. DANIELS, room 27, Telephone Building, representing the H. B. Camp Co., manufacturers of Camp's underground and interior conduits, of Aultman, Ohio, is supplying the Metropolitan Street-Railway Company with thousands of feet of Camp's conduits which are being installed all over the city, notably on Sixth avenue and Broadway.

A. WIRSCHING & SONS, of 61-63 Duane street, state that they are kept continually busy in order to catch up with back orders. They are manufacturing electricians, making a specialty of model and experimental work. They also deal in electrical instruments, telegraph supplies, printing telegraphs and appliances, etc.

NEW INCORPORATIONS.

Lawrence, Kan.—The Lawrence Railway Co. has been incorporated by R. W. Ludington, T. J. Sweeney, S. P. Moore, and others. Capital stock, \$250,000.

Meyer, Ill.—Missouri and Illinois Telephone Co. has been incorporated, with a capital stock of \$2,500.

New York, N. Y.—Electrical Export Co. has been incorporated; to deal in electrical goods. Capital stock, \$20,000.

Jersey City, N. J.—Consolidated Incandescent Light Company has been incorporated by Thomas F. Bedle, Pierre F. Cook and Francis H. McGee. Capital stock, \$500,000.

Chicago, Ill.—Jefferson Electric Light Co. has been incorporated by M. A. Ford, Harry Ferguson and William M. Copeland; for electric light and power purposes. Capital stock, \$50,000.

Havana, Ill.—Havana Telephone Co. has been incorporated, with a capital stock of \$5,000.

Jackson, Miss.—The Jackson Light, Power & Railroad Co. has been incorporated by S. T. Carnes, H. H. Corson and others. Capital stock, \$150,000.

Westfield, N. J.—Iron Clad Resistance Co. has been incorporated, with a capital stock of \$25,000; to supply electricity.

Albany, N. Y.—The Buffalo, Tonawanda & Niagara Falls Electric Railroad Co., a reorganization of the Tonawanda Street Railroad Co., has been incorporated by Henry B. Smith, H. M. Gillett, T. E. Ellsworth, James A. Roberts and others. Capital stock, \$1,250,000.

Portland, Me.—F. L. Merrill Co. has been incorporated by George C. Owen and Fritz H. Jordan; to deal in hardware and electrical supplies. Capital stock, \$100,000.

Kalamazoo, Mich.—The Kalamazoo Valley Electric Co. has been organized by W. A. Foote, J. B. Foote, C. H. Frisbee, R. H. C. Hoagland and S. S. Hurlburt. Capital stock, \$100,000.

Clarksdale, Miss.—The Clarksdale Water & Light Co. has been incorporated by Walter Clark, E. L. Anderson, W. P. Holland, P. H. Porter and W. D. Cutrer. Capital stock, \$35,000.

New York, N. Y.—The Storage Battery Supply Co. has been incorporated by T. D. Bunce, F. E. Foster and W. E. Foster. Capital stock, \$12,000.

Charlotte, N. C.—The Southern Electrical Co. has been incorporated by S. B. Alexander, Jr., and others; and has purchased and will succeed the electrical department of the Charlotte Machine Co. Capital stock, \$10,000.

Winona, Miss.—The Winona Ice, Electric Light & Water Co. has been organized by E. B. Blackston, D. B. Turner, C. S. Harris, William H. Witty, and others; for the erection of an electric light plant. Capital stock, \$100,000.

Woodruff, S. C.—The Home Telephone Co. has been incorporated, with E. F. Pearson, president; L. H. Irby, secretary, and S. J. Workman, treasurer.

It is well known that the absorption of ordinary light causes the production of heat. It has now been shown that the Roentgen rays are capable of causing the same effect. X rays passing through a diaphragm of lead were allowed to impinge upon a vacuum tube containing platinum foil. The absorption of the rays by the apparatus caused a perceptible rise of temperature. That this was not due to any stray radiant heat wandering about was proved by putting a source of heat nearer to the tube than the X radiator was, and observing that no effect was produced on the tube with the platinum.—London Invention.

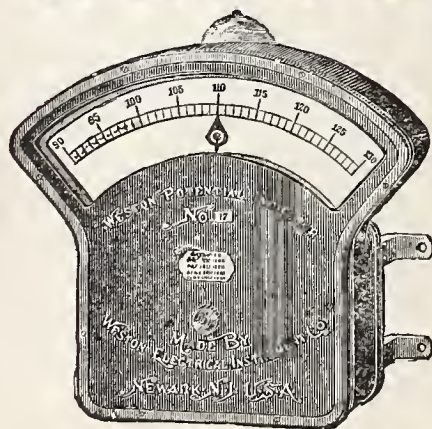
Sioux City, Iowa.—\$50,000 is being expended by the Iowa Telephone Co. on the plant in this city.

Rochelle, Ill.—The telephone system of the Lee County Telephone Company has been completed.

Quincy, Ill.—The Thomson-Houston electric-light plant owned by the same company at Quincy, has been purchased by W. B. McKinley, of Chicago, who represents an Eastern syndicate.

Houghton, Mich.—Peninsular Electric Light & Power Company has increased capital from \$150,000 to \$200,000.

WESTON STANDARD ILLUMINATED DIAL STATION INSTRUMENTS.

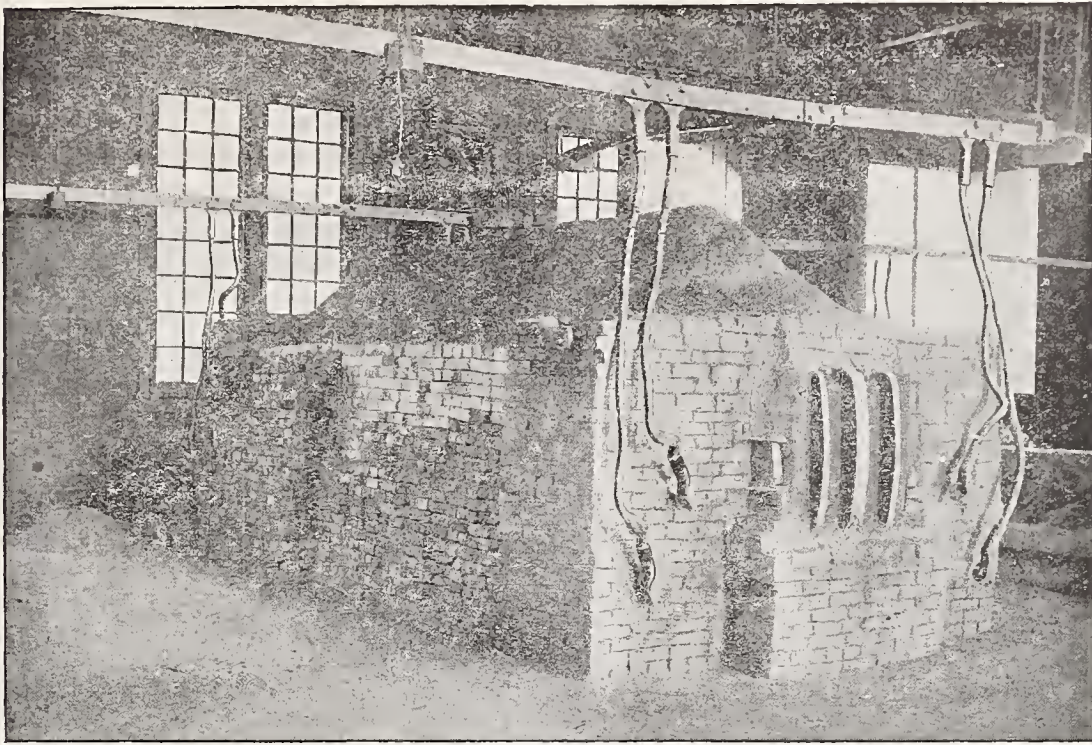


THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

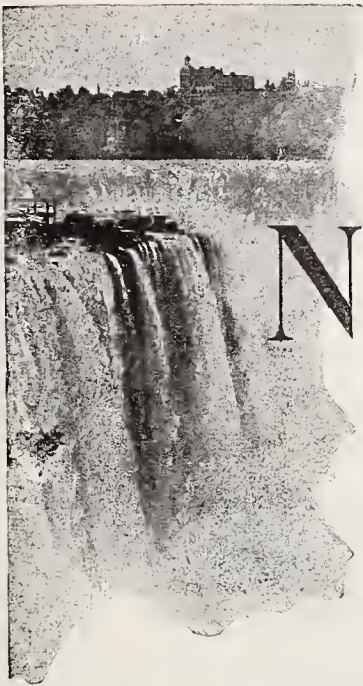
114-120 William St., Newark, N. J., U. S. A.

PRODUCTS OF THE ELECTRIC FURNACE.



Carborundum Furnace Ready to Burn.

CARBORUNDUM : ITS ORIGIN, MANUFACTURE AND USE.



NO new field of science can develop apart from parallel industries. Associated with the increasing use of electricity, we find a host of new substances dependent upon it for their existence, among which carborundum is certainly the most interesting. To produce this remarkable crystal all that is necessary is an iron pot holding a layer of carbon, serving as one electrode, a carbon rod, acting as the other electrode, and a mass of carbon and clay, through which the current passes. With this simple apparatus and sufficient electrical energy the mixture, raised to a terrific heat for some hours and then allowed to cool, will be found to contain crystals of carborundum.

From a commercial standpoint, this experiment is of tremendous importance. From a scientific point of view, it represents a successful experiment doubly interesting because it points to a new discovery that may be the forerunner of others of inestimable value. In fact, the electric furnace will be the means of solving some of the great mysteries connected with the formation of gems and minerals and, possibly, even the primitive condition of matter itself. Furnaces in which carborundum is made may be called arc and incandescent furnaces. In the first type the electrodes were movable, the arc produced between them being used to play upon the mass from which carborundum would be produced. This system was abandoned, and the incandescent furnace took its place.

Mr. E. G. Acheson discovered carborundum in 1891 and experimented with both kinds of furnaces, finally adopting the second in conjunction with the process involved in its use, on account of its extreme practicability

and efficiency. In this furnace a core is used which has either been taken from an old furnace or is built up anew from a mixture of sand, salt, sawdust and coke. Carborundum is the carbide of silicon, but was supposed to be a combination of carbon and aluminum until further experiments proved clearly that silica was indispensable, the quality of the carborundum depending entirely upon it. As larger and larger furnaces were used, the preliminary processes gave rise to a purer and better product than ever before.

In 1895 the furnace room of the Carborundum Company, at Niagara Falls, N. Y., held five actively operating furnaces. Each furnace was nine feet long, one foot nine inches deep, one foot eleven inches wide, and held a core eight feet long. The furnaces in use today are sixteen feet long, five feet wide and five feet deep. The core formerly used was rectangular in cross-section, but has been changed to one that is circular, measuring nine inches in diameter. Difficulty was experienced at first, due to the formation of gases in the incandescent mass and the formation of craters, with a subsequent eruption like that proceeding from a miniature Vesuvius. By mixing sawdust with the sand, coke and salt, the mixture, being filled with interstices, allows the free escape of gases to take place without these symptoms.

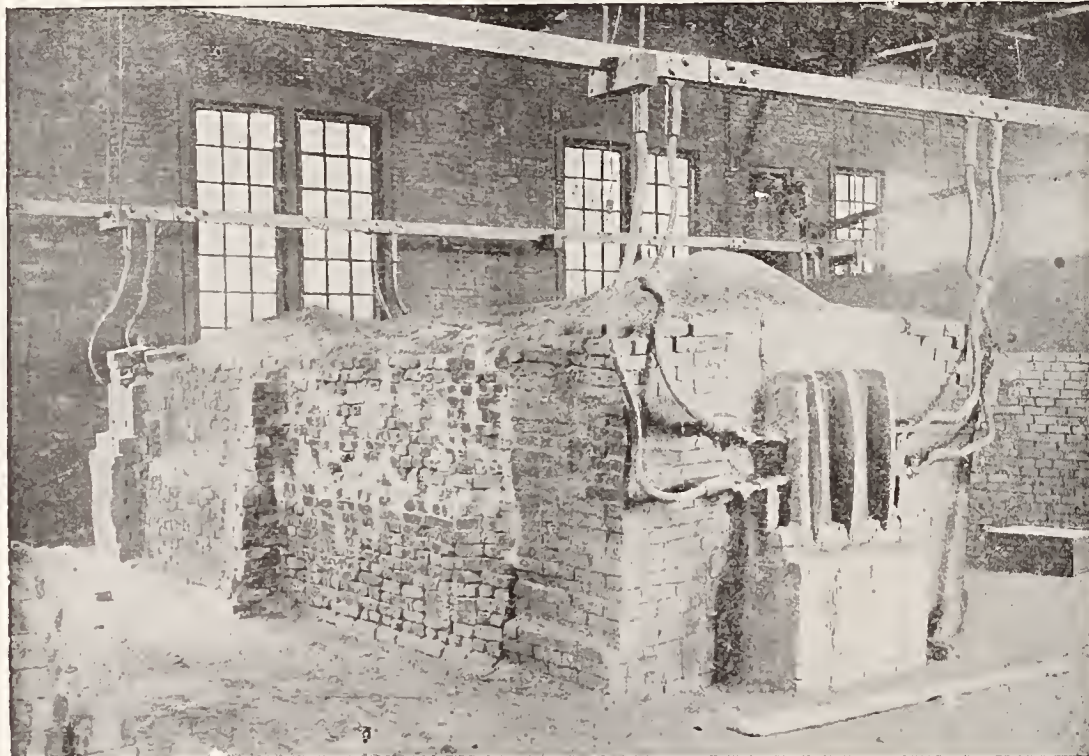
In the larger furnaces three hundred pounds of carborundum per day is produced. In the original small-sized furnaces a quarter of a pound per day was all that could be obtained. Two thousand horse power hours are required in a furnace possessing a capacity of three hundred pounds of carborundum a day; consequently each pound of carborundum produced requires a consumption of seven horse power hours. In preparing the constituents of the mixture for use, neither the sand, sawdust nor salt require further treatment, but the coke is put through a grinder and then through two cylindrical screens. In the first the coke dust is removed, while in the second the meshes are sufficiently large to allow those particles required for building up the core to fall through.

The weighing and mixing is done very readily by two men, and the mass is then brought to the furnace. Each

furnace is supplied with two terminals, consisting of sixty carbon rods, three inches in diameter and thirty inches long. An iron frame holds them in place; a plate of the same metal is bolted to the frame, with holes bored opposite each carbon rod. A copper rod three-eighths of an inch in diameter fits tightly into each carbon end. The interior of this box-like arrangement is then filled with graphite, tightly packed to make good contact. Heavy ribbed projections allow for connection with electric cables.

cold water. The pump drives the oil through the entire system, which includes, in all, the regulator, transformer and upper oil tank. The tank resting on the floor merely receives the overflow of oil. The oil being an insulator, may be freely circulated without risk, and, if kept cool, rapidly carries off all excess heat.

From the transformer two copper conductors lead into the furnace room. Each of these conductors is eight square inches in cross-section. In the transformer room is a rather unique switch. A great iron vessel, circular in

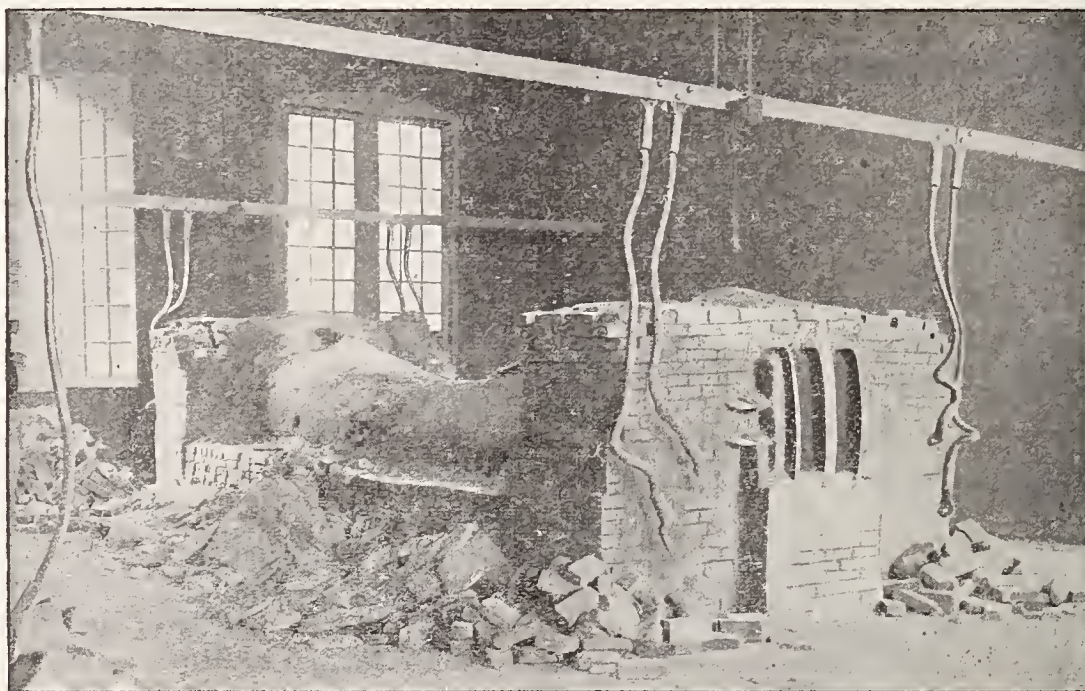


Carborundum Furnace Burning.

The electrical apparatus required for the manufacture of carborundum consists of a transformer, the second largest in the world, having a capacity of eight hundred and thirty K. W., or eleven hundred horse power. It transforms a twenty-two-hundred-volt current, received from the Niagara Falls Power Company, down to one hundred and eighty-five volts. The transformer possesses a regulator, the function of which is to raise the pressure to two hundred and fifty volts or reduce it down to one hundred. To keep the transformer cool and effectively

shape, holding a solution of salt and water, has suspended in it an iron plate. The iron plate connects to one pole of the circuit, and the iron vessel to another. When it is to be closed the iron plate is lowered into the water and touches the bottom. When the circuit is to be opened the plate is lifted completely out of the saline solution. This simple method of opening and closing the circuit saves expense, danger and difficulty.

The core is built up to within four inches from the carbon terminals at either end. The space between each



Carborundum Furnace After Burning.

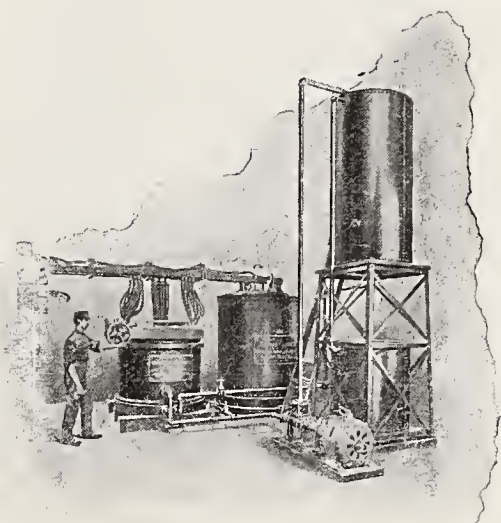
dissipate the forty horse power wasted in it as each oil is circulated through it by means of a small pump driven by a motor. The oil flows from one tank placed eight feet above the floor to the transformer. The upper tank is kept cool by means of two coils of pipe carrying

end of the core and the inner extremities of the carbon rods is filled with finely ground coke. Pieces of sheet iron are used to limit the length of the core during its building up. They are removed after the coke filling has been made. These furnaces are sixteen feet long inside,

five feet wide and five feet deep. At the bottom of each is a canal of cylindrical shape, ten and one-half inches in radius and the total length of the furnace. This canal receives the core, which weighs eight hundred and fifty pounds, if it has been previously used, or eleven hundred pounds if it is fresh and new.

A practical experience with old and new cores is an immense advantage in the manufacture of carborundum. The old core possesses a much greater conductivity than the new core. With an old core the current rises up to twelve hundred amperes. With a new core, in the beginning the current is very small. The resistance of either a new or old core rapidly diminishes, the carbon having a lesser resistance hot than cold. With an old core the energy consumed in one hour will reach one thousand horse power. The current is systematically reduced until the core possesses a fixed resistance; it then flows through uniformly. At the end of twenty-four hours the current is discontinued and the furnace allowed to cool. Meter readings taken at regular intervals of a quarter of an hour give, by calculation, the total watt consumption in each furnace.

The core of a carborundum furnace possesses an outer layer of almost pure graphite, which was first mistaken for carborundum crystals. An examination of this material leads to the conclusion that graphite is not formed directly from carbon, but combines, during incandescence, with some other compound, which is subsequently decom-

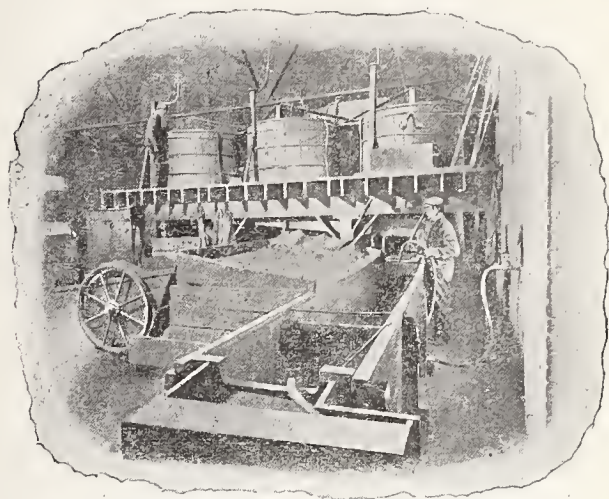


One of the Largest Transformers in the World.

posed, leaving behind crystals of graphite. While the current is passing through the furnace, gases escape in large quantities, a single furnace throwing off thousands of cubic feet of carbon monoxide.

The following description of the manufacture of carborundum in a furnace from the time the current is applied until discontinued may be found in a lecture delivered before the Franklin Institute, December 11, 1896, by Francis A. Fitzgerald, on "the Manufacture and Development of Carborundum at Niagara Falls." "After the circuit has been closed in the transformer-room no apparent change occurs in the furnace for about half an hour. Then a peculiar odor is perceived due to escaping gases, and when a lighted match is held near the furnace walls the gas ignites with a slight explosion. When the current has been on for three or four hours the side walls and top of the furnace are completely enveloped by the lambent blue flame of carbon monoxide gas, formed by the combination of the carbon with the coke with the oxygen of the sand. At the end of four or five hours the top of the furnace begins to subside gradually, fissures form along the surface, from which pour out the yellow vapors of sodium. Occasionally the mixture on the top of the furnace is not sufficiently porous to allow the rapid escape of the gases; the result is that the latter accumulate until the pressure is so great that at some weak in the mixture above a path is forced open and the gases

rush out violently. This is termed 'blowing' by the workmen, and the phenomena accompanying it are frequently as follows: a fissure suddenly forms at some point in the top of the furnace, and from this burning gases rush out with a loud, roaring sound. A miniature crater rapidly forms, from which white-hot cinders are thrown to a height of several feet, the issuing gases meanwhile burning with a dazzling yellow flame, dense white vapors soon



Where Carborundum Receives Its Chemical Treatment.

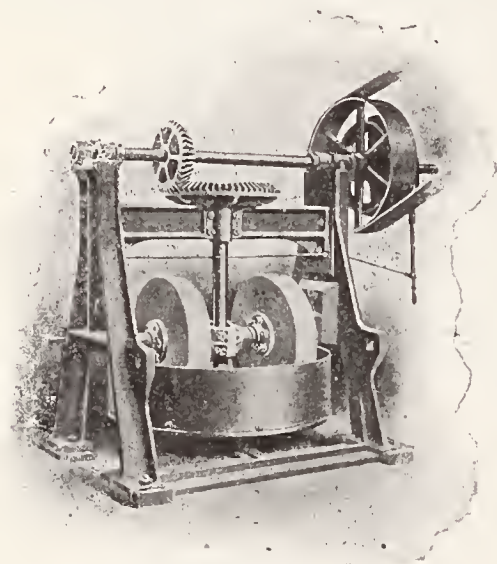
filling the furnace-room. In a bad case of this kind it is necessary to shut off the current from the furnaces and allow the latter to cool down somewhat. Then the mixture surrounding the crater is dug out to a depth of about two feet, exposing the blowhole, which is removed, and the cavity formed filled up with fresh mixture. At the end of about twenty-four hours the furnace is allowed to cool. Then the side walls are taken down and the unchanged mixture raked off the top of the furnace until the outer crust of amorphous carborundum is reached. This crust is cut through with large steel bars and can then be easily removed from the inner crust of amorphous carborundum. The inner crust is next removed with a spade and the crystalline carborundum exposed." Around the original core the carborundum crystals may be found which, in a furnace of this kind, amounts to four thousand pounds. These crystals are exceedingly beautiful. They are in fact but slightly removed from the diamond and might, if found in nature in limited quantities, be just as precious. But nature does not produce carborundum. The temperature at which it is produced is so near the point of its decom-



A Section of the Kiln Room.

position that, unless conditions be artificially controlled, its production is impossible. The cross-section of the core governs the temperature of the mass, therefore, if this is retained at a certain area the crystalline formation of carborundum is assured. The output of each furnace

in carborundum crystals is solely dependent upon the core. After the carborundum has been removed from the furnace it is crushed in a grinder, then washed in a bath of dilute sulphuric acid. This takes several days, after which it is dried and the various sized crystals assorted, ranging from number 8 to number 220; that is to say, the number 8 size will pass through a screen having eight meshes to the inch, and intermediate sizes, up to 220, are correspondingly finer. The powdered carborundum consists of the F, FF, and FFF grade. These grades are determined by the length of time it takes for the finer particles, when mixed with water, to settle to the bottom. Naturally the finest grade of flour carborundum, taking the longest time to settle, is the last to be labeled. Carborundum, in comparison with emery, is cheaper in the end, because it will do more work, faster work and better work than this material. The carborundum wheel, being lighter than the emery wheel, is considerably safer at high speed. The Carborundum Company manufacture wheels whose diameters reach from thirty-six inches, or three feet, to one inch, the wheels varying in



The Grinder.

thickness from four inches to a quarter of an inch. The immense variety of wheels manufactured by this concern will reach to such figures as eighty thousand. This does not include special forms, dental wheels, hones, sharpening stones, cloth, paper, etc.

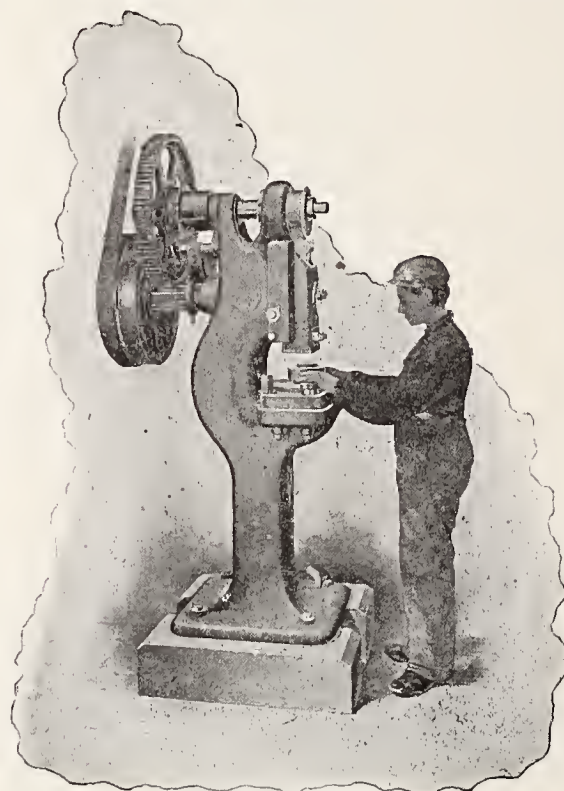
Carborundum is generally placed on the market moulded into shape with kaoline and felspar. A hydraulic press is used for this purpose. The wheel or moulded article is then burned in a kiln for seven days. The intimate mixing of the carborundum with kaoline and felspar, and the subsequent firing, makes a wheel of tremendous strength and durability. The vitrified bond is not the only one employed, shellac being occasionally used. Carborundum has displaced the diamond with watchmakers, and emery with shoe manufacturers. Its lasting properties in this case are six times as great. Plate-glass manufacturers invite its use, and, for smoothing up "biscuit ware," porcelain and pottery firms find it a superior article. For the grinding of car wheels its reception has been most enthusiastic, and in many other cases too numerous to mention, it has found permanent application. The Carborundum Company of Niagara Falls, N. Y., have developed the manufacture of their product on scientific lines. They have reduced operating expenses to a minimum, and consequently offer their goods to consumers at the lowest market price.

The executive officers are, Mr. E. G. Acheson, president; R. B. Mellon, vice-president; H. H. Williams, treasurer; W. H. Arison, secretary, and F. J. Tone, superintendent. The board of directors is composed of Messrs. A. W. Mellon, of Pittsburg, Pa.; R. B. Mellon, of Pittsburg, Pa.; W. C. McCallister, of Monongahela, Pa.; W. H. Arison, of Niagara Falls, and E. G. Acheson, of Niagara Falls, N. Y.

THE PRESENT AND PROSPECTIVE SUPPLY OF CALCIUM CARBIDE.

The rapidly increasing use of acetylene has pushed the demand for calcium carbide so close to the present limit of available supply that the questions of increased productive capacity, the future output, and probable price of this new and important material assume a definite international interest.

It is understood that the use of acetylene, and consequently the consumption of carbide, has increased somewhat more rapidly in America than in Europe, and that, notwithstanding the large output at Niagara Falls, the home demand has rather more than kept pace with the supply. The latter may practically be also said of Europe, at least of Germany, which country, notwithstanding its preeminence in all kinds of chemical manufacture and all that one hears and reads of new plants



Small Press.

projected or under construction, still obtains almost its entire supply of carbide from Switzerland, notably from the great works at Neuhausen.

A year ago about the only manufacturer of carbide in Germany was a company at Bitterfeld, in Prussian Saxony, which smelted the lime and carbon by electrical heat generated by steam power, and found itself, for that reason, unable to compete, and so suspended operations and removed its plant to Neuhausen, where it has reopened with water-power generators and a largely increased capacity.

The whole carbide industry, so far as central Europe is concerned, is now in a transition stage, and the conditions of supply and price are likely to be greatly modified by the increased production of next year. The Compagnie Genevoise, at Vernier, on the Rhone, near Geneva, has greatly enlarged its plant and is making contracts for 1899 at a considerable reduction from present rates.

But the most important accession will come through the operations of the great combination headed by the Schückert Electrical Manufacturing Company, at Nuremberg, which, as is stated on published authority, will increase its capital to 28,000,000 marks (\$6,664,000) and expects to have in operation during the course of next year the following carbide factories:

	Horse-power
Electrical Works Lonza, at Gampel (Wallis)	2,500
Electrical Works Hofslund, at Sarpborg, Norway,	5,000
Bosnian Electrical Company, Iajce, Bosnia,	8,000
Société Espagnole, Brega (Catalonia)	2,500

The aggregate annual product of these four plants is estimated at 20,000,000 kilograms (20,000 metric tons), capable of generating 6,000,000 cubic meters (211,896,000 cubic feet) of acetylene. Besides these, the Aluminium Industry Company, of Neuhausen-on-Rhine, has this year increased its capital to 16,000,000 francs (\$3,088,000) for the purpose of constructing a 7,500-horse power plant at Land-Gastein, in Austria. All these establishments will employ the original process, by which the lime and carbon are smelted together by the heat of an electric current.

The Walther process, briefly described in a former report of this series,† smelts the same materials by the heat of darting acetylene flames intensified by mechanical pressure, and is employed by a company at Leipsic, which has works at Cassel, and now advertises its product in the special organ of the carbide industry. Although this company is said to have exhibited at Berlin carbide samples of very high quality, there seems to prevail among business men some doubt—which may be only the conservative prejudice that discredits all new things—as to whether this process can be made to compete economically with electrical heat generated by water power under favorable conditions. So far as can be ascertained, a favorably located and well-managed water power plant in Germany or Switzerland ought to produce carbide of standard quality at a net cost of 160 marks (\$38) per metric ton, and it is doubted whether this minimum figure can be much reduced by any process now in practice. The consumption of acetylene will have to increase rapidly after next winter to keep pace with the great augmentation in the carbide supply that will then occur.

Already the effect of this future increase in production exerts a definite influence upon contract prices, and a large purchase for next year's delivery has recently been made at a reduction of 20 marks (\$4 76) per 100 kilogram (220 pounds) from the market price of the same firm for 1898. Carbide is a form of merchandise which varies exceedingly in price according to the quantity involved in the transaction. So far as can be ascertained, manufacturers now receive from railways and other consumers or wholesale dealers who purchase in large quantities from 34 to 35 marks (\$8.09 to \$8.33) per 100 kilograms, packing charges not included. Consumers of small quantities have to pay to dealers from \$10.25 to \$11.90 per 100 kilograms, exclusive of packing, the price between these two figures being governed by the quantity purchased.

The standard guaranteed strength is 300 liters of gas per kilogram of carbide, and the present situation may be summarized as follows:

There is now in the European market no apparent surplus of carbide, and the current supply is taken up as fast as it is turned out.

There is even a demand that would justify some importation, provided the foreign-made carbide were of standard quality and could be furnished at prices within the local market rate and under conditions of delivery and payment that prevail here.

This situation can probably not continue beyond the close of the present year. The several large new carbide plants that will be started up next winter and spring will so increase the output as to probably reduce the market price to a fair profit above net cost of production, and, unless the use of acetylene increases phenomenally, leave a surplus that will be available for export.

Calcium carbide is, however, a somewhat critical kind of merchandise for international traffic. The requirements of railways and steamship companies in respect to packing, etc., are so costly and difficult of fulfilment that in one recent case a large order of carbide for China had to be canceled because it was impossible to comply with the specifications for its transportation.

† See Consular Reports No. 206 (Nov., 1897), p. 337.

FLASHES.

Livingston, Mont.—The Livingston electric light plant, damaged by fire at a loss of \$32,000; insured for 24,000.

Fitzgerald, Ga.—Moore & McRary have been awarded contract for construction of electric-light plant.

Slater, Mo.—Electric-light plant dynamo burned out, and city left in darkness.

CONDUCTORS.

THE RELATIVE COSTS OF COPPER, ALUMINIUM, AND IRON WHEN USED AS ELECTRICAL CONDUCTORS.*

By John B. C. Kershaw, F. I. C.

In an article published by the writer in August, 1897, it was shown that at the prices of aluminum and of copper current at that date, the former metal was one and a half times as costly as the latter when used for electrical conduction purposes; the cost ratio being calculated for wires of equal conductivity.

Early in the present year Mr. A. E. Hunt, of the Pittsburgh Reduction Company, published a similar article,† and, taking as his basis of calculation figures slightly different from those used by the writer in his earlier article, he proved that so far from aluminum being the more costly metal for electrical transmission, it was slightly the least costly of the two.

Since the subject is an important one, the writer has thought it advisable to recalculate the relative costs of aluminum and copper conductors of equal electrical capacity, using in the one case Mr. Hunt's data, and in the other case his own; in order to include in the comparison a third metal which has more than once been proposed as a medium for the conduction of large electrical currents, such as those used in electro-chemical and electro-metallurgical works, he has extended the calculations to the corresponding values for iron.

In the following expressions

S = sp. gr. of copper,
P = cost price per pound of copper,
C = conductivity of copper,

and s , p , c represent the corresponding values for the metals, aluminum and iron.

It is evident then that the expression

$$\frac{S \times P}{s \times p}$$

$$s \times p$$

will represent the relative costs of equal lengths of wire of equal sectional area, and that the expression

$$\frac{S \times P \times c}{s \times p \times C}$$

$$s \times p \times C$$

will represent the relative costs of equal lengths of wire of equal electrical resistance.

The values used by Mr. Hunt in his article upon the use of aluminum as an electrical conductor are the following:

Copper.	Aluminum.
S = 8.93	s = 2.68
P = 14 cents per lb.	p = 29 cents per lb.
C = 100	c = 63

Substituting these in the expression given above, we

* London Electrical Review.

have $\frac{8.93 \times 14 \times 63}{2.68 \times 29 \times 100}$ which equals $\frac{7,876}{7,772}$ or, $\frac{101}{100}$, as the

relative costs of copper and aluminum wire of equal lengths and equal electrical resistance. This ratio is in close agreement with that found by Mr. Hunt by a somewhat more indirect method of calculation.

Taking next, values for copper and aluminum less arbitrary than those selected by Mr. Hunt, and repeating the calculation, we have—

Copper.	Aluminum.
$S = 8.93$	$s = 2.68$
$P = 5.94d. \dagger$ per lb.	$p = 15.85d. \dagger$ per lb.
$C = 100$	$c = 59$ (99 % aluminum.)

$$\text{and } \frac{8.93 \times 5.94 \times 59}{2.68 \times 15.85 \times 100} = \frac{100}{135}$$

This result confirms the early calculation of the writer, and shows that for conducting purposes 99 per cent. aluminum at the present market prices of the two metals is $1\frac{1}{3}$ times as costly as copper. The cost of converting the ingot metal into wire of equal electrical resistance would not materially affect the ratio, since, although the copper would be of less sectional area and consequently would have to be passed through a greater number of draw-plates, greater care would have to be exercised in the case of the aluminum, and the costs of drawing would probably be about the same. Aluminum of 99 per cent. purity has been taken for comparison, because 100 per cent. aluminum is not yet a commercial product, and the writer doubts whether the Pittsburg Reduction Company, or any other aluminum producing company, will ever be able to produce 100 per cent. aluminum in wire or rod form profitably, at the price taken in Mr. Hunt's calculation, namely, 29 cents per lb.

The values for iron and the calculation of the relative costs of copper and iron when used for conducting purposes are given below :

Copper.	Iron.
$S = 8.93$	$s = 8.10$
$P = \text{£}55$ 10s. per ton.	$p = \text{£}3$ 12s.
$C = 100$	$c = 16.4$

$$\text{and } \frac{8.93 \times 1,110 \times 16.4}{8.10 \times 72 \times 100} = \frac{162,661}{58,322} = \frac{2.78}{100}$$

This result shows that if iron can be produced in bar form with a conductivity of 16.4 Matthiessen standard, at a price of £3 12s. per ton, it is by far the cheapest metal for electrical transmission purposes ; and, though its weight as compared with copper or aluminum prevents its use for overhead lines, there would seem to be no reason why it should not be used for underground conduits, or for electrical current transmission in works and factories where the lightness of the conductor is of entirely secondary importance, and where the current is of low potential.* The liability of iron to rust could be overcome by artificially forming the protective oxide, Fe_3O_4 , as a skin upon its surface in the manufacturing operations, or by applying a coating of tar at a later stage.

Gathering the results of these calculations together, and expressing them as cost ratios to iron, taking the latter as 100, we have

* The *Aluminum World*, February, 1898, also *ELECTRICAL REVIEW*, 42,

† These prices are taken from current price lists, and represent the true relative values of electrolytic copper, and aluminum at the present date.

Relative Costs of Conductors of Equal Length and Equal Electrical Resistance.

Metal.	Purity and Price.	Relative Costs.
Aluminum...	99 per cent. at present market prices...	375...
Copper.....	Electrolytic " " " " " " " " " " " "	278...
Aluminum...	100 per cent. at A. E. Hunt's value...	275...
Iron.....	At present market price, plus 38 per cent. for rolling costs.....	100...

WATER POWER INSTALLATIONS.

LACHINE RAPIDS PLANT AND THE COST OF PRODUCING POWER FOR GENERATING ELECTRICITY THEREFROM.*

By W. McLea Walbank.

In order to allow of a fair comparison with other plants of the cost of producing power for generating electricity from the Lachine Rapids plant, the writer considers it desirable to give you a brief outline of the hydraulic as well as the electrical equipment of our works.

The world-renowned Lachine Rapids, as you are all doubtless aware, is situated on the St. Lawrence River, a short distance from the city of Montreal.

The idea of converting the wasted energies of these turbulent waters and harnessing them for the use and convenience of man was not new. As far back as 1866 a company was formed, whose object was to erect dams and construct large hydraulic works, about a mile lower down the river than the site of the present power house; their object being to induce factories to establish their works at the rapids, for at that date the possibilities of electric transmission had not been demonstrated. The scheme, however, never materialized, and since that date various projects have from time to time been talked of, but never matured.

In the fall of 1895 the Lachine Rapids Hydraulic & Land Company, Ltd., commenced its operations. The directors commenced work only after having fully satisfied themselves upon the difficulties to be encountered and overcome, and carefully studying the question of back water, frazil and anchor ice, and went in with a determination to succeed.

The company was honestly formed, without "ground floors" or "sub-cellars," with a bona fide capital, on which every share represents one hundred dollars (\$100) cash. This, the writer considers, has direct bearing on the cost of producing electricity, because a company handicapped by what is called watered stock, or exorbitant promoter salaries, has to pay interest on money it never had the use of.

Having therefore formed a company on a solid and firm financial basis, the property fronting on the Lachine Rapids, and controlling the water power privileges, was secured, and operations for the development of the water power commenced.

Hydraulic Development.

The hydraulic plant consists of a main dam and power house, one thousand feet long, and a wing dam and guard pier, five thousand feet long, forming a head race or basin with an average depth of twelve feet in low water.

To secure this it was necessary to divert the waters of the St. Lawrence and lay bare the bed of the river for a distance of over a mile and remove over 400,000 cubic yards of rock.

The main dam, which is constructed of a series of isolated cut stone piers, with head gates and stop logs, furnishing in all thirty-six (36) flumes and three (3) waste weirs, at the same time forming foundations for the power house and turbine sheds.

* Read before the National Electric Light Association.

The Electrical Age.

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A NEW INSULATION FOR CONDUCTORS.

The present method of insulating wires is that involving the use of rubber, gutta percha, cotton and silk. The covering of large wires represents but a small percentage of its diameter. The covering of small wires increases rapidly with respect to the diameter, so that the finer sizes possess a covering of silk, cotton, etc., all out of proportion to their size. Three difficulties present themselves in connection with the covering used at present for electrical conductors. First, the insulation occupies a considerable portion of a space allotted to the winding. Second, the filling up of this space requires a length of wire dependent upon the thickness of insulation possessed by the wire. Third, cotton insulation, particularly, is easily charred by an undue rise of temperature in the winding.

Conductors used for interior wiring or outside lines are, of course, protected by either rubber, gutta percha, or a compound of both. The question of space does not arise, but the ease with which the covering can be attached has given rise on frequent occasions to dead grounds and short circuits. The flexibility of the insulating covering is not always up to the standard, in consequence of which sharp bends in the wire mean a fracturing of the insulation and, possibly, an exposure of the copper core. Generally speaking, wires used for outdoor and indoor use are otherwise very well protected from injury. The outdoor wire is supported by insulators and is installed in such a way that, even though its insulation was stripped from it, immediate danger of grounding would be entirely absent. Wires used for interior work, incased in conduits, are similarly protected; a naked wire in such being very nearly as well protected as one covered with heavy insulation.

But for armature and field winding the case is different.

Frequently potential differences of ten, twenty-five, fifty, and more than one hundred volts are only separated from each other by the slightest of insulation. The greatest care must be exercised by armature winders in obviating the risks of grounds and short circuits. Cotton covering is readily affected. It deteriorates rapidly under the influence of certain liquids and soldering fluids, and is so readily abraded that considerable difficulty has been experienced in the past and present, due to this fact alone. The proper insulation for a wire is undoubtedly one which adheres tightly to the conductor, possesses a degree of flexibility that will respond to the actions of an external force without breaking, and possesses non-conducting properties great enough to allow of the thinnest application to insure absolute insulation.

A dressing for wires of this description would certainly insure freedom from many of the faults that cotton and silk possess. It would be more in the nature of a coating than a woven texture, and would save at least five per cent. in the weight of copper used and ten per cent. in the winding space. Manufacturers desiring to build compact machines would, by the use of mild steel frames and a thoroughly reliable insulation, be able to produce motors and dynamos lighter and better than ever before. There is a chance here for some enterprising inventor to discover this new coating for wire.

At present, in order to make certain of the insulation of cotton-covered wires, it is necessary to make free use of shellac, but when a wire is once shellacked, the previous flexibility of the covering completely disappears, and the additional insulation due to the shellac is secured at too great a sacrifice. Hence the necessity for securing both flexibility and insulation in the new covering for wires.

FIRE CAUSED BY A SIMPLE ACCIDENT.

A contemporary of ours, the "Street Railway Review," states that on May 26th, 1898, an employé of the Southside Elevated, Chicago, caused a fire by dropping an iron tool, thereby making connection between a gaspipe and the third rail. The short circuit burnt through the pipe, ignited the gas and caused a fire. Traffic was interrupted for several hours. The wiring in quite a few cars was destroyed and the cars were nearly burnt, and in some few other details injury was wrought to the establishment which figured up to quite a considerable loss. A similar case occurred in New York in which a street laborer, digging near the Edison mains, dropped a crowbar. The short circuit, in this case, was very severe, fuses blowing throughout the station, and the greatest excitement prevailed for nearly an hour. Frantic efforts were made to burn out the short circuit. The laborer was only made aware of this when he attempted to lift the crowbar. The temperature of it gave rise to suspicions on his part that the strength of certain liquid refreshments he had partaken of was greater than he anticipated. The crowbar, having been carelessly thrown down and not used for nearly an hour afterward, did not actually cause a fire but interfered with the operation of the station, and it was not until it was removed that the station was able to supply current to the neighborhood. Simple causes like these have often interfered with the operation of large plants and sometimes caused, in addition to financial losses, a loss of life.

An interesting experiment has just been started on the Philadelphia, Wilmington and Baltimore Railroad in order to find out which is the best wood for telegraph poles. Some forty-two have been set up in order to test the life of the various woods employed. There are six chestnut poles, creosoted; six pine poles, creosoted; six chestnut poles, woodline; six set in broken rock, six set in clay, six in the ordinary manner, and six to have a hole bored near the ground so that they can be saturated with oil.—Exchange.

The total development will, when completed, consist of seventy-two (72) vertical turbine wheels and twelve (12) generators. The wheels connected in series of six, by gearing, to a horizontal shaft, at the end of which a generator is directly connected. The completed power house will contain twelve (12) such sets. The whole as shown on the accompanying blue prints.

Of the total installation forty-eight (48) wheels are already in place, and the power house, head race, tail race and dams are completed.

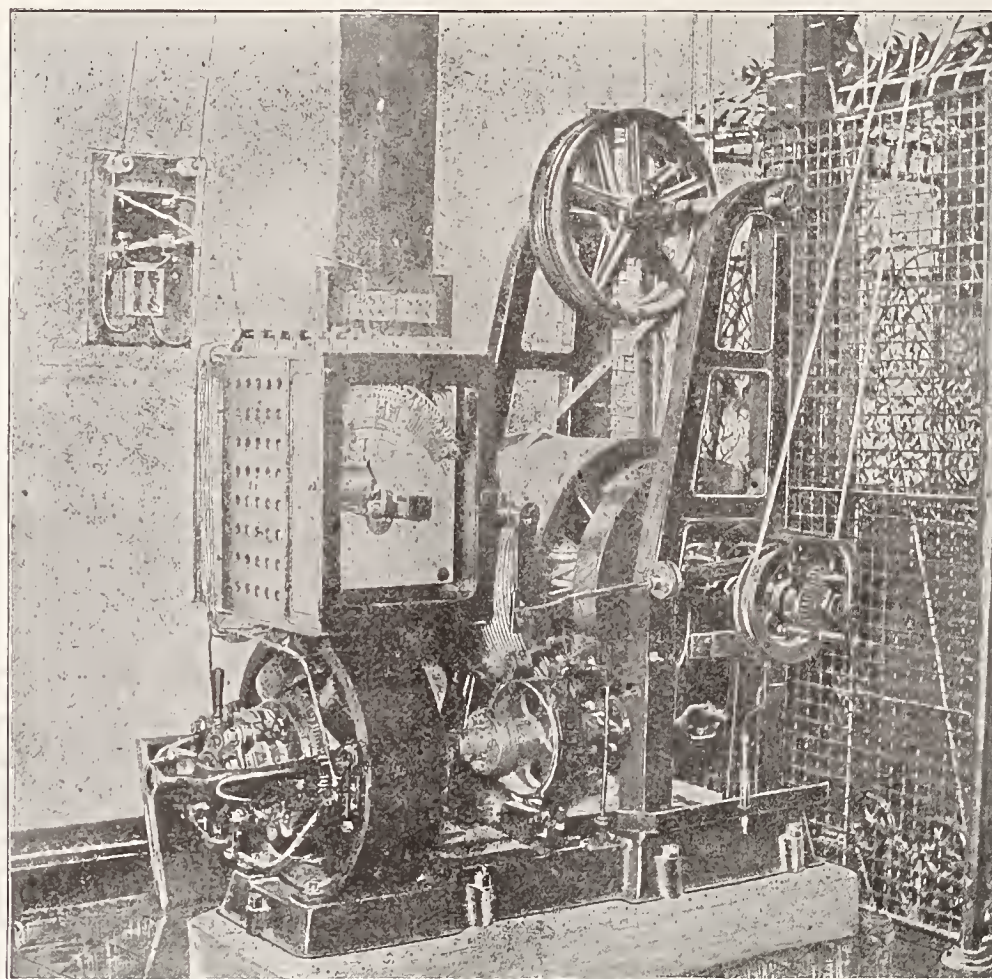
Electrical Equipment.

Each dynamo house will contain four (4) three-phase General Electric alternators, wound for 4,400 volts at

which would make the total possible output of our power house about 16,000 kilowatts.

Cost.

Perhaps the greatest obstacle to a fair comparison of electric current produced by water power, as against the same current produced by steam, is the first cost. In the former case, especially if a large water power is to be developed, the expense of the whole installation, such as dams, head and tail races, etc., has usually been made at the commencement, while perhaps only a fraction of the power thus obtainable is at once used, therefore throwing a very much larger capital cost per unit than with a steam plant, which need only install the power necessary for im-



Commercial Electric Co.'s Elevator Equipment.

full load, and two (2) direct-current exciters at 120 volts. There will be in the total installation three such dynamo houses, containing in all twelve (12) dynamos and six exciters, each exciter being capable of exciting four (4) machines. Each dynamo house will have its own switchboard, of blue Vermont marble, of the very latest design, so arranged that each circuit may be operated from the switchboard of either power house. The floors are of slate and the building of solid brick. The current is generated at 4,400 volts, avoiding the use of step-up transformers, is transmitted on iron poles over bare copper wire to the city of Montreal, a distance of about five miles, to the sub-stations, where the pressure will be lowered to 2,300 volts, and by means of sub-station switchboards subdivided into the desired units and distributed partly through underground conduits, and partly by overhead construction, throughout the city of Montreal and its suburbs, where we find a population of over 300,000 people offering a market for light and power.

Of the total equipment one-third is already installed.

Total Power.

The wheels were tested at the Holyoke testing flume, on April 16th and 17th, 1897, and developed at full gate as follows:

With a speed of 76 1-4 revolutions, discharging 235.33 cubic feet of water per second and developing 300.84 horse power, showing an efficiency of 81.32 per cent.,

mediate demand and continue increasing or adding thereto, as the demand therefor offers.

(To be continued.)

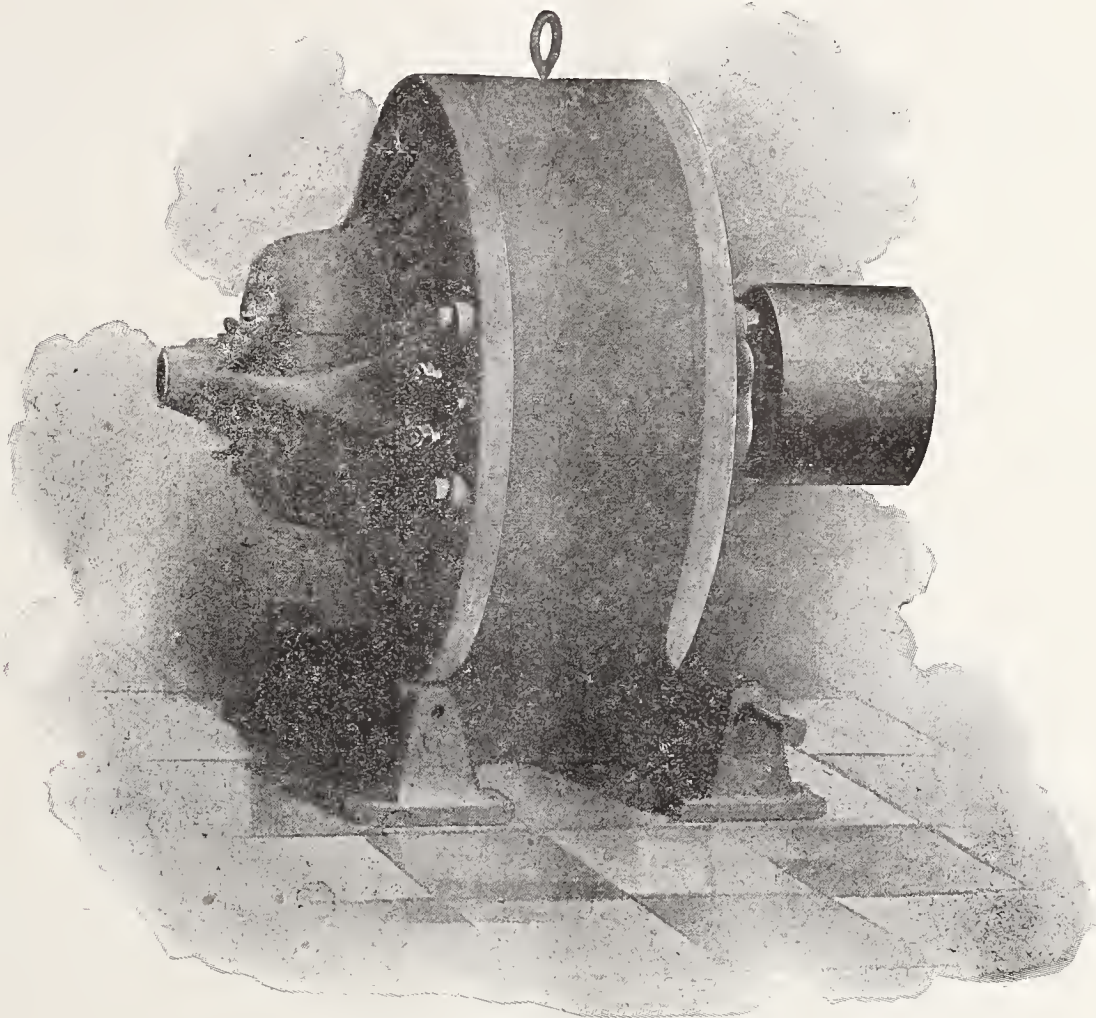
LIGHT AND POWER.

ELECTRIC LIGHT AND POWER MACHINERY.

Correctness of design in the construction of light and power machinery usually exercises a great influence upon its future success. Questions of economy have given rise to a new school of design, and in consequence of this the manufacturer desiring to introduce his apparatus with success must feel assured that it will stand the light of scientific criticism without injury. The lighting and power machinery of the Commercial Electric Company, of Indianapolis, Indiana, betrays a care in construction and design that is sufficient in itself to make them worthy of a good introduction. The direct-connected generators are substantially built. The fields are made of mild steel, in consequence of which a given magneto-motive force produces a field of force twice as strong as that given by cast iron of equal cross-section, with the same ampere turns. Pole shoes of cast steel are employed, so as to provide the proper magnetic spray or sparkless commutation. In this respect two birds are killed with one stone—spark-

less running, in consequence of which the commutator will remain unaffected for years. The field coils run cool, are wound on spools with brass flanges and are well protected, externally, by a heavy, cord winding. The speed of the armature is regulated according to specifications, although it is the practice of this company to supply two speeds for a given size of machine. The armature adopted by the Commercial Electric Company is of the gramme ring type. The laminated core,

it at a healthy temperature at all loads. The commutator, built up of copper segments of uniform temper and insulated from each other with the best India mica, combines strength with usefulness, solidity with long life. The use of carbon brushes on all direct-connected machines relieves them from all but occasional inspection. The regulation is so perfect within the prescribed limits of load, due to a perfect adjustment of parts, that neither brushes nor rheostat under any circumstances



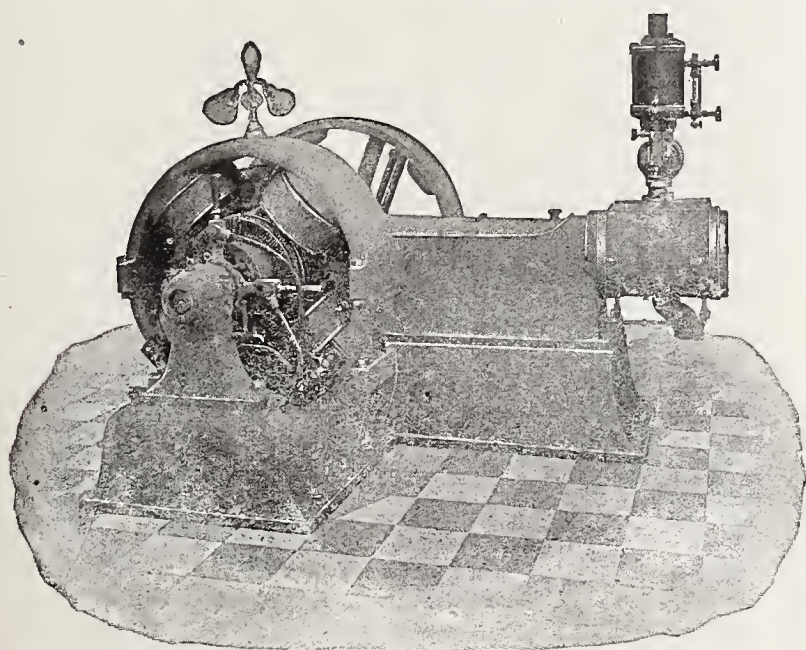
Commercial Iron Slow Speed Motor.

built of the best charcoal iron, is supported by a spider of brass.

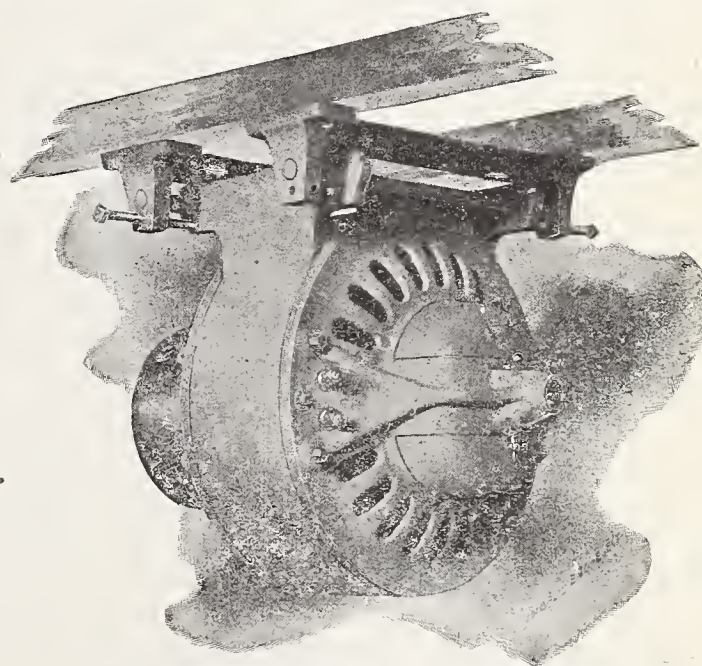
The advantages of a gramme armature are obvious. Coils of greatest difference of potential are ninety degrees apart, whereas in the drum armature such coils

need ever be touched. In consequence of this, motors fed from these generators, whether loaded or not, do not affect its electromotive force or cause a perceptible flicker in the lights.

For direct connection with gas engines, small Commer-



Commercial Dynamo Direct Connected to Economic Engine.



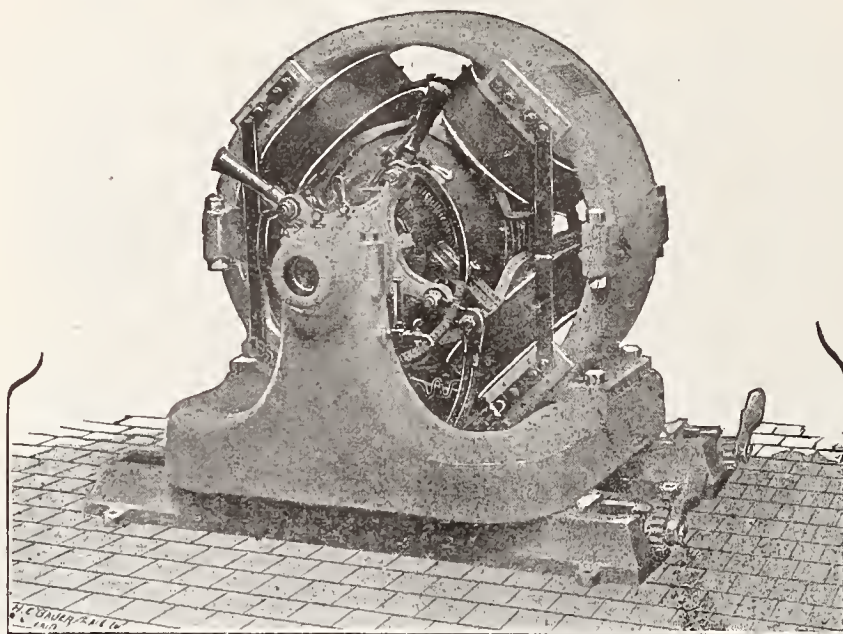
Method of Ceiling Suspension.

overlap each other; this dangerous proximity being the frequent cause of burn-outs. Each coil is separate from its neighbor and can be replaced with such celerity that repairs of this kind would never cause the least embarrassment. Ventilation is not artificially forced in this armature, its immense radiating surface keeping

cial Electric generators have proven their remarkable superiority. Small residential plants of this description require but a minimum amount of attention and, on account of the high efficiency of the generator, give the best possible returns for the cubic feet of gas consumed. One of the great advantages connected with

the use of these generators and motors is to be found in their interchangeability of parts; those requiring duplication may be instantly refitted in the time it takes to drop a line to their factory, at Indianapolis, Indiana. The slow-speed motors of the Commercial Electric Company are ideal machines in respect to weight, compactness, efficiency and operation. Ventilation is readily obtained, while at the same time protection is gained by the use of an iron casing. The field frames proper are made of cast steel, the permeability of which, according to Steinmetz, is about that of wrought iron. The field coils, wound on forms, have mica insulation. They are readily removed, and cannot be injured except by absolute carelessness or deliberate intention. The temperature rise is normal, the radiation being perfect. The brushes, of the radial carbon type, are of ample cross-

wholesale warehouses where goods are bought from samples, the question of artificial illumination presents a difficulty not, heretofore, easily solved. In no place is it more important to have a perfect light than in stores where clothes, cloths, silks, colored textiles of all kinds, fine glassware, delicate porcelains and chinaware are sold, and in none can a poor light work more harm to the owner by illy showing his goods. Many cases can be recalled in the experience of every store proprietor, in which perfect matches of color by the artificial light on which he has had to depend have turned out unhappy marriages as soon as they were exposed to the pure white light of the sun, to the dissatisfaction of the customer and frequently the loss of his custom. What salesman has not been compelled to carry heavy rolls of cloth or bolts of silk to the store doorway to show that colors and



Commercial Generator for Direct Connection.

section, can be subjected to a variable tension, and may be easily removed.

The Commercial Electric Company's motor for ceiling suspension or ordinary floor work is provided with self-oiling bearings, and is built with a field frame of mild steel. Its design, in detail, has been given the same careful attention as the other machines of this company. The motor once installed, either on the ceiling or floor, cannot lose its alignment, as it is rigidly held. On account of its excellent design, it does not heat under any circumstances and will not spark. Being perfectly automatic, after installation they require little or no attention. Each part is interchangeable, and all the comfort and convenience found in the ownership of a modern machine will be experienced by purchasers procuring these types. The Commercial Electric Company's slow-speed electric motors exclude the possibility of injury by dust or climatic changes.

Prepared to meet all exigencies, the generators and motors of the above company represent a form of investment constantly paying dividends to the purchaser. The enclosed motors have a particularly desirable method of support, by which their suspension from the ceiling or installation on the floor will give entire freedom for operating the belt-tightening device without necessitating the loosening of the suspension bolts or other apparatus for holding the machine up. They are very conveniently applied to freight elevators on this account.

LIGHTING OF STORES AND WINDOWS BY ELECTRICITY.

ELECTRIC ILLUMINATION OF LARGE STORES.

In all stores in which the goods require the most perfect display at all times during the business day, such as department and dry goods stores generally, as well as

shades are vastly different in the light of day than in the interior of the store gaslit or lighted by open arc electric lamps?

The perfect illumination of dry goods and department stores, and, indeed, all stores of a kindred character, has hitherto been an unsolved problem. Gas burning from an ordinary burner is far too garish and yellow. Used in an incandescent mantle, the light is too greenish and sallow. In both cases, colors are falsified in a manner which the ordinary observer would consider impossible, and which to the practiced eye is almost inconceivable. The primary colors become complementary, and the complementary colors become almost anything. An additional drawback is to be found in the deleterious effect on the eyes of the employes, which tend to lose that power of color selection which is a prime necessity.

To secure a greater volume of light from a single source and to do away with the upright gas flame, the open arc lamp was adopted, first with a clear globe and then with a globe of opalescent glass. This, while a decided advance on gas as a store illuminant, had many disadvantages. When first introduced, separate circuits had to be provided, and not until the introduction of what is known as the incandescent circuit arc lamp, a very few years ago, were arc lamps really within the practical reach of the dry goods store proprietor.

The intensity of the light from an open arc lamp lights up part of the store too brilliantly, while it throws the other part into deep obscurity. Even with the most careful distribution to avoid shadows, the cross lights from the open arcs caused inconvenience. Furthermore, with open arcs, there is always a certain amount of sparking at the arc, by which heated particles of carbon are given off, frequently passing over the top of the globe and falling in the vicinity of the light. As the heat from them is not immediately extinguished, their very presence is a danger. Indeed, in the last report of the Electrical Bureau

of the National Board of Fire Underwriters occurs this item:

"Sparks from carbons of arc lamps not provided with spark arrester set fire to dry goods stock; loss, \$300."

What sparks do not fall outside should tumble through the bottom of the globe into a dust pan, but usually they collect on the interior surface of the globe, to be brushed into the surrounding air and fall upon the goods, or be blown into the eyes of the salesmen or customers when the attendants change the carbons.

Open arcs, burning evenings only, practically consume three carbons every two days. Those used in dark stores and burning all day consume many more. Three carbons for each two days for 300 lighting days is 450 carbons per annum and 300 visits of the lamp trimmer. If the store proprietor pays for his carbons, they cost him each year \$13.50; and even if he do not, still he cannot dispense with the lamp trimmer, whose visits are timed for all hours of the day, and to whose inconvenient presence the loss of many a sale can be set down.

Within a very recent period a new type of electric light has been introduced. It has successfully been put on the market by the General Electric Company and owes its development and present perfection to the genius of Prof. Elihu Thomson. It is an arc lamp, with the two carbons burning in an air-tight globe filled with the inert gas which the combustion of the carbons creates. By enclosing the arc in this globe the life of the carbon is tremendously lengthened, and instead of burning only ten hours, they burn from 90 hours, in the arc lamp used with alternating currents, to 150 hours, in that used with the direct current. Apart from the economy in carbons which the use of this lamp brings about, the visits of the trimmer, instead of occurring daily, occur only every ten or fifteen days, or longer, depending, of course, upon the time of year and the period of daily illumination. Roughly, it may be said that with 150-hour lamps and ten hours' illumination per day, trimming is necessary only about twenty to twenty-five times a year, instead of 300 times, and twenty carbons suffice instead of 450—60 cents instead of \$13.50. In stores using many lamps, such an economy would have a deep significance.

The frequency of trimming of the open arc lamp largely increased the chance of breakage of the large globes. With the trimming visits reduced to 20 or 25 per annum, the chance of breakage is greatly diminished, and in the G. E. lamps, by the use of a special lowering device, almost wholly eliminated.

The point, however, of greatest importance to the dry goods store is the quality of the light. From the enclosed arc lamp the light emitted is a pure white light, and its diffusion through the walls of the globe is as perfect as possible with any artificial light. The result is almost equal to the light of day, a light which cannot falsify colors, a light under which goods of any color may be shown, with the assurance that if taken to the store door no difference in shade can possibly be seen. It is different from any other light artificially produced, and it is the only light upon which reliance can be placed to give dry goods stores a perfect illumination.

In open rooms each lamp can be depended upon to satisfactorily illuminate 600 sq. ft. of space, but where a department has, suspended from its ceilings, draperies, portieres, rugs, carpets or other samples for display, which necessarily obstruct the light, the floor space illuminated would not be so great, and the lamps would have to be installed more freely.

The enclosed arc lamp is manufactured in two styles, known as the double globe and single globe. In both the mechanism is similar in every respect, and the carbons burn in similar small globes. In the single lamp, however, the place of the large outer globe is taken by a special widely flared glass reflector, with a highly polished under surface. The double-globe lamp is used where an

absolutely even diffusion of the light is required; the single-globe lamp where greater intensity and some concentration beneath the lamp is necessary. The enclosed arc lamps are constructed for use on alternating-current circuits, as well as on direct-current circuits, the duration of the life of the carbons being somewhat shorter in the alternating than in the direct-current lamp. For interior lighting both single and double-globe lamps are made up with different styles of ornamental casings in different finishes. For outdoor use the double-globe lamp alone is used in a black japanned casing.

THE WHEELER SYSTEM OF REFLECTORS.

Where light is required of an intensity that must be varied to suit conditions, a system of reflectors must be employed which will distribute the light successfully. The absorption of light energy is what must be avoided during its distribution, hence the efficiency of a system of reflectors is as important as the effects produced by its employment. The Wheeler system of reflectors possesses scientific features which have made their use a practical success on account of the proper relations having been observed between the source of light, the locality to be illuminated and the reflector distributing the light. With this system of reflectors light produced by electricity, gas or oil, is most efficiently utilized.

The silver-plated corrugated reflector of the Wheeler Reflector Company is used for lighting any circular area by arc lights; the light reflected by this appliance is white and powerful. Its diameter is thirty-two inches.

By inverted arc lighting, representing an innovation in the illumination of interiors, all the effects of daylight are successfully imitated. With the light thrown up against the ceiling and reflected from white walls a diffusion of radiant energy is obtained which is equivalent to artificial daylight. These reflectors are green outside and white enamel inside. The billiard-table shade obviates the glare proceeding from a naked lamp and sends down a pleasant, mellow light agreeable to the eyes and in every way conducive to the comfort of the player. They have been universally adopted in public pool-rooms and private billiard-rooms.

The street car fixtures of this company include a great many interesting novelties. Their silver-plated mirror reflector, used in conjunction with a three-light fixture of polished brass, has met with great success. The silver-plated mirror reflector can be used with a fixture holding more than three lights, if required. The illumination produced by this device enables passengers of street cars to read and see with perfect ease.

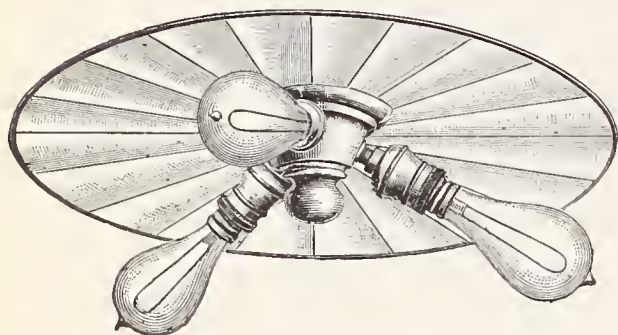
Foot lights, metal half shades and pulpit hoods represent a class of devices that find their place in the theatre and lecture hall. The foot-light reflectors are green outside and bright tin inside. The metal half shades are green outside and white inside, and the pulpit hood, which will fit a three and a quarter inch shade holder, is bronze outside and glossy white within.

The silver-plated reflector referred to above finds a ready application in commercial establishments, such as stores, exhibition halls, etc. The rays of light are reflected by it over a great area of surface. In construction it is convex and fulfils its functions admirably in projecting the light exactly where required. When it is necessary to throw a strong, clear light upon a limited area, the silver-plated mirror reflector, shown in illustration, with silver-plated mirror plate glass within, is exceedingly effective for show-window lighting and over lathes, work benches and desk lighting. The percentage of light thrown down is very great and is effectively delivered. The incandescent reflector, of about the same shape and size, is merely enamelled white inside and green outside. Its use for architectural and desk work is obvious. The incandescent reflector is made in a variety of sizes. It is provided with rubber or porcelain rings and dispenses in one type with the shade holder. The field of work cov-

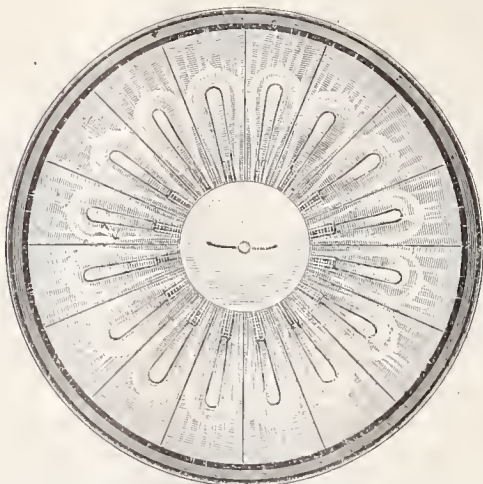
ered by the Wheeler Reflector Company, of Boston, Mass., is large enough to include all systems of interior and outdoor illumination and the use of all known illuminants.

light allows the sign to be changed. The absolute satisfaction its use entails has led to its universal adoption in the United States by street railway and cable companies.

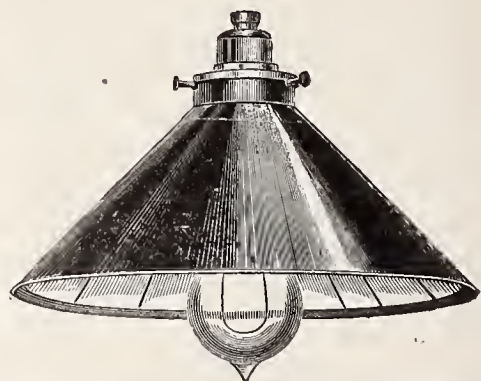
THE ILLUMINATION OF SHOW WINDOWS.



Silver Plated Mirror Reflector.



Under View of Wheeler Window Reflector.

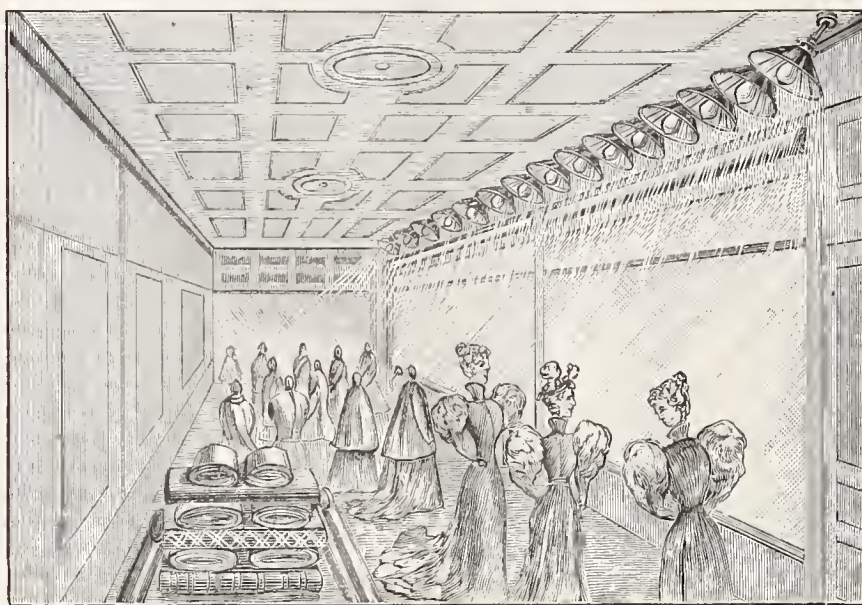


Wheeler Reflector for Incandescent Lamps.

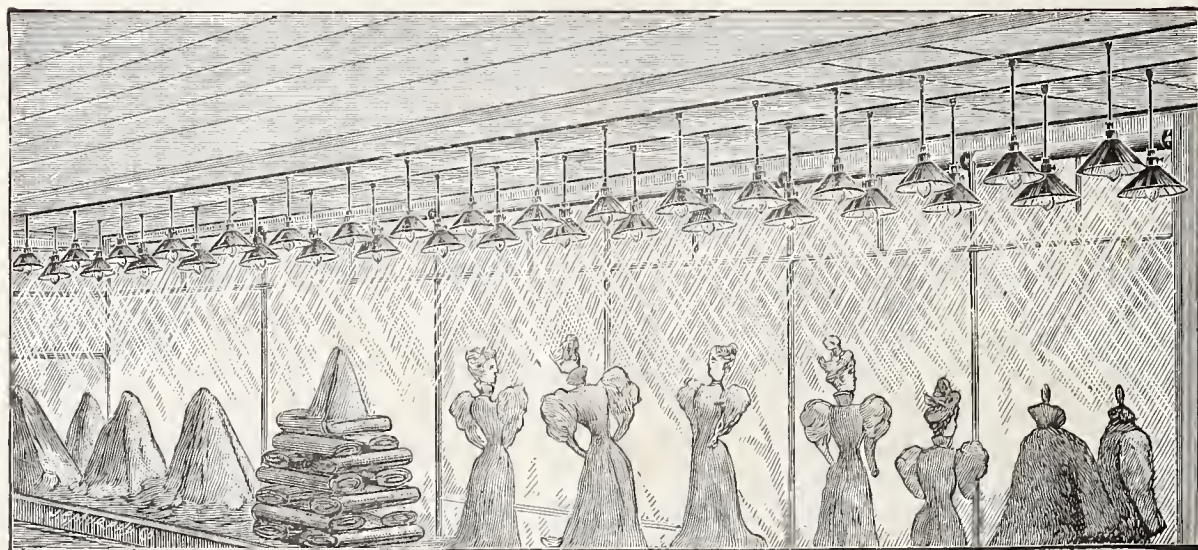
ELECTRIC HEADLIGHTS FOR SURFACE CARS.

Their headlights for electric cars are a familiar sight in all metropolitan cities. The reflectors of these headlights are parabolic. Those used for dashboard or vestibule are provided with a malleable iron case. They weigh only ten pounds, and are protected from injury by the

The success of many a store may be traced to its window lighting. The proper illumination of show windows is in part an art and a science. It is an art as regards the degree of illumination required, and a science in its most efficient and effective distribution. There are two methods; the first consists of the use of reflectors on ball



Example of Show Window Lighting with Wheeler Reflectors.



Example of Show Window Lighting with Wheeler Reflectors.

buffer, which projects further beyond the car than the headlight. They are dust-proof and very bright.

The Columbus Avenue line, of this city, use the Wheeler Reflector Company's oil headlight, fitted with their patent rotating sign, which indicates the route or destination of the car. A knob on the left side of the head-

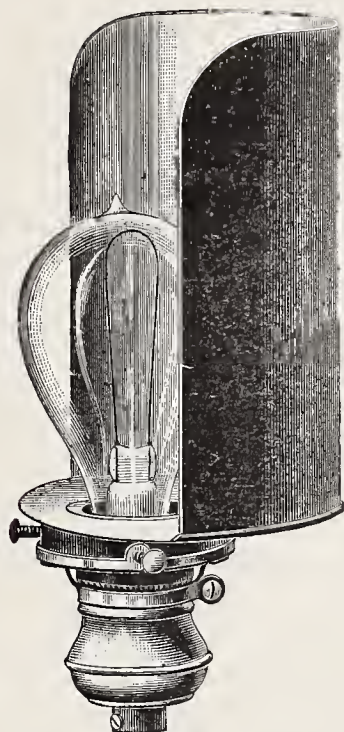
and socket brackets, situated as shown in illustration, the lamps placed close to the ceiling illuminating the show windows, yet not appearing in view themselves. Illumination is a great success in this case. The store windows of Jordan, Marsh & Company, R. H. White & Company, etc., utilize this system. The second method, shown in

illustration, involves the use of reflectors placed n ceiling in one row or many. This is very populaw the great majority, limits the cost of installation to a nominal figure and gives great satisfaction. The Wheeler reflector used for this purpose is lined with sixteen converging strips of silver plated mirror glass, as shown in illustration; each one fully reflects the light of the lamp. The illuminating power of the light at the centre is thereby increased fifteen times. These reflectors are made in

Macon, Ga.—The electric light plant of the Macon Gas Light & Water Company has been purchased by the Macon & Indian Springs Street Railway Company.

Wahoo, Neb.—The power house of the electric light was completely destroyed by fire.

Atlanta, Ga.—The Mayor may be addressed concerning the establishment of a municipal electric light plant



Foot Light.



Oil Head Light with Rotating Signs.



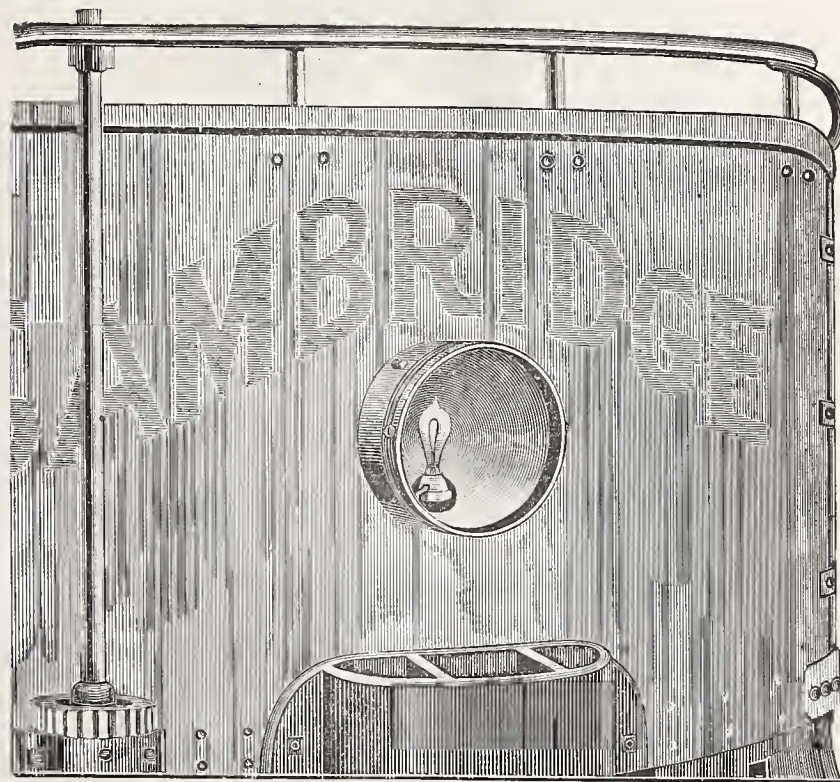
Billiard Table Shade.

three sizes, seven, ten and twelve inches in diameter.

The immense satisfaction their use implies can be more thoroughly appreciated by reference to such concerns as Shepard, Norwell & Company, dry goods; H. H. Tuttle

Clarksburg, W. Va.—A movement is on foot to erect an electric light and power plant.

Chattanooga, Tenn.—The Rapid Transit Co. will erect an electric light plant, to be located in Highland Park.



Parabolic Reflector for Dash Board or Vestibule.

& Company, boots and shoes; J. A. Glass & Company, paper hangings, etc., etc. For further reference, address the Wheeler Reflector Co., 24 Washington street, Boston, Mass.

Somerville, Tenn.—An electric light plant, to cost \$10,000, will be established.

Lynchburg, Tenn.—An electric light plant will be established.

Detroit, Mich.—The works of the Michigan Electric Company, dealers and manufacturers of electrical supplies, were greatly damaged by fire on September 24 to the extent of about \$50,000.00.

STREET-RAILWAY SPECIALS.

The electric switch installed at the junction of Flatbush and Third avenues, in Brooklyn, a year ago, by the New York Switch & Crossing Company, has proved such a success that when the company change the curve they intend to put in a new switch of the same make.

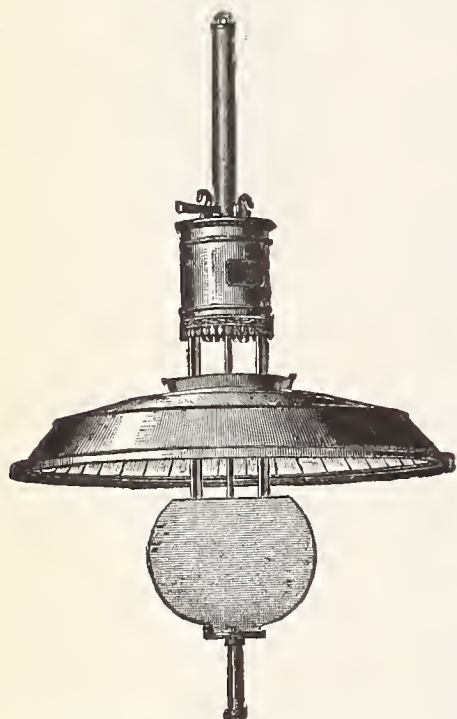
The recent tests on the King's County Elevated R. R., of Brooklyn, have been completed and in a month's time the whole system will be operated by electricity on the third-rail system. For the past week thorough tests have been made with a train of five cars headed by a motor car equipped with four 125-H. P. Westinghouse motors, operating on an eight per cent. grade, between Ralph and Reid avenues. These trials have given the highest satisfaction and work is being rapidly pushed to complete the change of motive power from steam to electricity.

When the Putnam and Halsey Street lines of the Brooklyn Heights R. R. Company were changed from horses to electricity the terminal at Broadway was a deserted spot, composed mainly of vacant lots. For the last five years this neighborhood has improved so rapidly that three years ago the company were forced to extend their lines

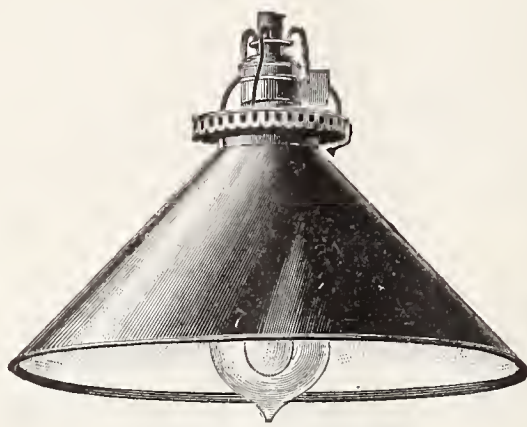
ing eighteen in all, nine on each side, complete the seating equipment. The panels inside are fitted with highly polished French mirrors. The car is fifty feet long, is handsomely painted in orange with terra-cotta panels. It is provided with Brill's double trucks and brakes. Two K-10 G. E. controllers and two No. 1,000 motors of 25-H. P. capacity each. There are running boards on each side of the car. In good weather the windows are let down within the panels, and the panel windows and all are slid up between the ceiling and the roof; the running boards let down and the transformation into an open car is complete. This car is one of the most successful of its kind. It is neither a freak nor is it complicated. It represents the forerunner of an order for fifty which the Brill Company is working hard to finish for the Brooklyn Heights R. R. Company. F. H. ROTH.

POSSIBLE INSTALLATIONS.

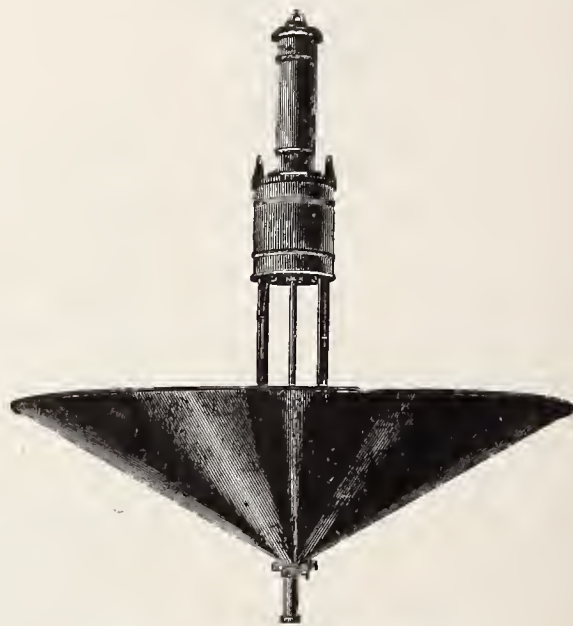
Shelbina, Mo.—The Mayor may be addressed concerning bonds to the amount of \$5,000, which have been issued for the purpose of increasing the power of the electric light plant.



Silver Plated Corrugated Reflector.



Incandescent Reflector.



Inverted Arc Lighting Reflector.

to Hamburg avenue. Prior to this there were no streets cut through, no police protection and no street lighting at this point, which really represented the boundary line of Kings and Queens counties. Traffic has so increased in the last few years that the company has decided to extend the line from Hamburg avenue to Ridgewood.

The Third Avenue line of the Brooklyn Heights R. R. Company has suffered considerable inconvenience and blockade through a curve found at the junction of Flatbush and Third avenue. The company never ran anything but small cars on that line, but since the extension of the road to Coney Island the traffic became heavy enough to necessitate the use of new cars with a seating capacity of ninety passengers. These long cars meeting at the curve caused trouble on account of each motor-man wanting to go around first. A car in the hands of a green man was certain to cause trouble. This has all been remedied. Last Wednesday evening a large force of men were put to work and a new curve built in ten hours. Cars now pass each other freely and no delay has since then been occasioned.

The finest street-car operating on street service is car No. 787 of the Third Avenue line of the Brooklyn Heights R. R. Company. This car was built by J. G. Brill Bros., car builders, of Philadelphia, Pa. It is handsomely finished in ash with bird's-eye maple ceiling, beautifully decorated; seats with reversible backs, caned, number-

Mt. Pleasant, Mich.—A movement is on foot to issue \$7,000 bonds for an electric light plant.

Minneapolis, Minn.—F. W. Cappelen, City Engineer, may be addressed concerning the establishment of an electric light plant.

Braddock, Pa.—Steps are being taken to construct a municipal electric light plant.

Perham, Minn.—City Clerk may be addressed concerning establishment of electric light plant.

Fargo, N. D.—E. A. Hughes may be addressed concerning establishment of electric light plant.

Tallahassee, Fla.—The Mayor may be addressed concerning contemplated establishment of electric light plant.

Arlington, Ga.—The Mayor may be addressed concerning establishment of an electric light plant.

Winchester, Va.—William R. Willis may give information concerning contemplated erection of electric light plant.

Cullman, Ala.—Jas. E. Clark is interested in the Cullman Water & Lighting Co., which is being organized to construct water works and electric plant at an estimated cost of \$15,000.

Batesville, Ark.—An electric-light plant is to be constructed.

Jacksonville, Fla.—C. O. Patterson may be addressed concerning extension of electric-light system.

Jackson, Ga.—M. L. Hendrick may be addressed concerning contemplated erection of electric-light plant.

Henderson, Ky.—The mayor may be addressed concerning proposed construction of electric-light plant.

Ellisville, Miss.—An electric-light plant is in contemplation.

Kingwood, W. Va.—U. N. Orr may be addressed concerning the proposed establishment of electric-light plant.

NEW INCORPORATIONS.

Trenton, N. J.—The Trenton-Washington Light Co. has been incorporated by E. Raymond Perrine, New York; Forman H. Gordon, Windsor; Irvin Aaron, Doylestown; George E. Fell, Levi P. Updike, Trenton; to introduce in Trenton a system of lighting and heating. Capital stock, \$100,000.

Albany, N. Y.—The Dowd Electrical Co. has been incorporated by Charles Henry Fitch, Pepperell, Mass., and others. Capital stock, \$100,000.

Chicago, Ill.—The City of Lincoln Gas Co. has been incorporated, to furnish gas and electricity to the city of Lincoln, Ill. Capital stock, \$10,000.

Chicago, Ill.—The Chicago Suburban Water & Light Co. has been incorporated by Charles F. Vogel, J. M. Gibson and Charles B. Wood; to deal in water, gas and electricity. Capital stock, \$600,000.

Philadelphia, Pa.—The Standard Light and Heat Company has been incorporated by R. M. Robinson, Wm. L. Teter, E. C. Wharton, Henry Robinson, Philadelphia; Joseph W. Irwin, Govanstown, Md. Capital stock, \$1,000,000.

New York, N. Y.—Wetmore Electric Co. has been incorporated by George W. Pulver, Jacob Strife, Oliver P. Hedden and Thos. Glenn; to operate in the towns of Lowville, New Bremen and Croghan, and the villages of Lowville and Croghan. Capital stock, \$40,000.

Worthington, Ind.—Worthington Water & Light Co. has been incorporated, with a capital stock of \$5,000.

Keeseville, N. Y.—Keeseville Electric Co. has been incorporated by Orville S. Morse, H. M. Prime, A. W. Boynton and others. Capital stock, \$30,000.

Baltimore, Md.—Electric Gas Light Co. has been incorporated to manufacture and sell machines for the generation of acetylene gas. Capital stock, \$10,000.

Indianapolis, Ind.—Indiana Storage Battery Co. has been incorporated by Charles F. Smith, Loren S. Dow and Anthony J. Wilson. Capital stock, \$100,000.

NEW YORK ITEMS.

DAVID CHALMERS, manager of the New York office of the Holtzer-Cabot Electric Co., 112 Liberty street, and the only Dave in the electrical trade, is wearing his usual complacent smile as he says that all the trade seems to migrate his way. None of the out-of-town notables of the electrical profession ever fail to pay him a visit when in town, as they consider him to be one of New York's attractions.

H. H. CUTLER, of the Cutler-Hammer Manufacturing Company, Chicago, manufacturers of high-grade rheostats, was in town last week.

J. JONES & SON, 64 Cortlandt street, manufacturers of switches and dealers in electrical supplies, have their works taxed to their utmost capacity in order to keep up with the orders in hand. They have been obliged to add

2,500 square feet more of floor space to their present works for the manufacture of their specialties.

GEORGE GARVIN, of the Garvin Machine Company, Spring and Varick streets, manufacturers of all kinds of machine tools, returned from Europe last week, where he has been looking over the company's large sales-rooms in Berlin, Germany, and Paris, France. He also brought some good business back with him and reports the outlook for foreign trade for American manufacturers very bright. The Garvin Machine Company do the largest business among electrical manufacturers in the United States.

STEIN & LANGLOS, of 221 Centre street, manufacturers of all kinds of electrical apparatus and supplies under contract for stock orders, are preparing to bring out a line of special electrical goods which they say will be big sellers. They also do all kinds of machine tools, model and experimental work.

CHARLES J. BOGUE, having removed to larger and more commodious quarters at 215 Centre street, is preparing to bring out a new line of electric-light specialties. He manufactures one of the best photo-engraving lamps and projectors on the market, and does all kinds of armature and commutator-repair work at the lowest figures, commensurate with the best workmanship.

THE GREATEST INTEREST-PAYING BOND in the country is the "Harrington," manufactured by the Harrington Rail Bond Company, 120 Liberty street. They will send a copy of their latest brochure to any one asking for the same and mentioning the "Electrical Age."

ERNEST A. LOWE, the genial manager of J. JONES & SON, has returned to his labors after an extended trip through the White Mountains. He tells some interesting bear and fish tales, but will quickly switch off to other matters, circumstances warranting it.

G. HUERSTEL, president of the International Electric Co., 76 Beekman street, has returned home after an extended business trip. The International Electric Company make a specialty of machine-screw work for binding posts of varied and assorted sizes as may be required, and were the first firm to make a specialty of Ruhmkorff coils for all purposes.

THE STORAGE BATTERY SUPPLY CO., of 239 E. 27th street, lately incorporated, are preparing a line of fine specialties to be used with their storage battery. As there is a great demand for these specialties they ought to prove excellent sellers.

The members and friends of the Alumni Association of the Hebrew Technical Institute are invited to attend an open meeting to be given under the auspices of the above association at the Tuxedo, Madison avenue and 59th street, on Saturday evening, October 1, at eight P. M. Mr. T. Commerford Martin, editor of "The Electrical Engineer," will deliver a lecture on "Edison; His Life and Work." The lecture will consist mainly of personal reminiscences, Mr. Martin having known "The Wizard" for a number of years, and will be illustrated by a large number of interesting lantern slides. If time permits, Mr. Martin will also show a number of lantern slides of Niagara Falls and their recent development for power purposes. Literary and musical exercises will be rendered and a solid evening's enjoyment will be in store for those intending to attend this affair.

TELEPHONE CALLS.

Newton, Kans.—The Newton Telephone Co., A. R. Champlin, manager, has decided to build a long-distance telephone line from this city to Moundridge.

Hagerstown, Md.—The Maryland Telephone & Telegraph Co. has been incorporated by Col. D. C. Winebrenner, Judge John C. Motter, Wilbur H. Duvall and others; to operate lines in Frederick, Carroll, Howard and other counties. Capital stock, \$20,000.

Indianapolis, Ind.—New Telephone Co. has increased its capital stock to \$400,000.

Springfield, Ill.—Perry County Telephone Co., DuQuoin, has been incorporated, with a capital stock of \$12,000.

Little Rock, Ark.—The American Telegraph & Telephone Co. has been incorporated; to connect Little Rock and Memphis, Tenn., by telephone.

Montezuma, Ga.—The Montezuma Telephone Co. has been incorporated by Jule Felton and Mrs. C. H. Maxwell; for the construction of a telephone exchange. Capital stock, \$1,000.

Vine Grove, Ky.—The Winchester & Lexington Telephone Co. has been incorporated by T. C. Vanmeter, David Prewitt and S. D. Goff. Capital stock, \$1,560.

West Plains, Mo.—The Mountain Home and West Plains Telephone Co. has been incorporated; to construct a telephone system from Mountain Home to West Plains. Capital stock, \$5,000.

Fergus Falls, Minn.—The Fergus Falls Telephone Exchange has been completed.

Hagerstown, Md.—The Cumberland Valley Telephone Co. promoters held meeting recently, and the entire amount of the capital stock, \$50,000, was subscribed and ten per cent paid in.

Albany, N. Y.—The Hudson River Telephone Co. has completed an addition to its extensive and complete service.

Bolivar, Mo.—J. C. Pike and H. S. Bruce will establish a telephone system.

Knoxville, Tenn.—The East Tennessee Telephone Co. equipment and franchises mortgaged to the Nashville Trust Co. for \$150,000.

Little Rock, Ark.—The American Telephone & Telegraph Co. has received franchise to construct a telephone system.

Cleveland, O.—The Cuyahoga Telephone Co. has been incorporated by E. W. Moore, J. B. Hanna, J. B. Hoge, H. Clark Ford, John Sherwin, H. A. Everett, and H. B. McGrew; to build telephone and telegraph lines in Ohio. Capital stock, \$3,000,000.

Salem, Va.—The Interstate Telephone & Telegraph Co. has been granted franchise to construct and operate an exchange.

Lumberton, N. C.—The Robeson County Telephone Co., A. W. McLean president, will construct a long-distance telephone line from Lumberton to Wilmington.

Charlotte, N. C.—J. A. Helvin is constructing a telephone system from Charlotte to Salisbury.

Albany, N. Y.—The American Telephone and Telegraph Co., of New York, has increased its capital stock from \$20,000,000 to \$25,000,000.

Chicago, Ill.—The American Electric Telephone Co. increased its capital stock from \$100,000 to \$130,000.

STREET RAILWAY NEWS.

Lansing, Mich.—Capitalists from Detroit contemplate building an electric railway from Lansing to Pine Lake.

Kalamazoo, Mich.—The Battle-Creek Kalamazoo electric line will be built by next spring.

Lawrence, Kans.—An electric street-railway line will probably be constructed in this city.

New York, N. Y.—The Nassau Electric Co. has increased capital stock from \$6,000,000 to \$15,000,000.

Lansing, Mich.—The Saginaw & Frankenmuth Railway Co. has been incorporated by Henry C. Potter Jr., James B. Peter, Samuel G. Higgins and William J. Bartow; to build an electric road. Capital stock, \$50,000.

Dunkirk, Ind.—Dunkirk and Redkey Traction Co. has been incorporated by Henry C. Billingsly, Charles A. Hanable and R. G. Hasbrouck. Capital stock, \$75,000.

Sodus Point, N. Y.—Rochester and Sodus Bay Railway Co., incorporated by George E. Merchant, Walter B. Duffy, Thomas J. Nicholl, Daniel G. Clapp, George Wilder and others; to operate by electricity, compressed air or other power, except steam, a railroad line, 41 miles long, from Sodus Point, Wayne County, to Rochester. Capital stock, \$1,000,000.

Lansing, Mich.—The Michigan & Indiana Railway Co. has been organized for the purpose of constructing an electric railroad connecting Niles, St. Joseph, Benton Harbor and other southern Michigan towns.

Monticello, Ind.—Tippecanoe Electric Railway Co. has been incorporated by Charles C. Spencer, Emory B. Sellers and others. Capital stock, \$50,000.

BUSINESS CHANGES.

Jacksonville, Fla.—The Citizens' Gas Co. have been granted letters patent. They have changed name from the Citizens' Gas and Electric Co. to above name. The liabilities of the company are limited to \$100,000.

Grand Rapids, Mich.—The Lowell Electric Light & Power Co. defunct; the creditors have succeeded in having a receiver appointed.

Brantford, Ont.—The directors of the Brantford Electric Light Co. have instructed their manager, Mr. Wyse, to proceed at once to purchase the necessary plant for the extension of the works.

Macon, Ga.—The Macon & Indian Springs Street Railway Company have purchased the electric light plant of the Macon Gas Light & Water Company, and have made arrangements for the erection of additional buildings, to be equipped with an entirely new plant.

Nevada, Mo.—J. B. Quigley & Co. have been granted franchise for the erection of an electric light and gas plant.

Lumberton, N. C.—Steps are being taken to establish an electric light plant in this city.

Houma, La.—Wilson & Jastremski will operate an electric light and power plant.



WESTON STANDARD

PORTABLE DIRECT READING

**VOLTMETERS AND
WATTMETERS**

**For Alternating and Direct
Current Circuits.**

The only standard portable instrument of the type deserving this name.

Write for Circulars and Price Lists
8 and 9.

WESTON ELECTRICAL INSTRUMENT CO.
114-120 WILLIAM STREET, NEWARK, N. J.

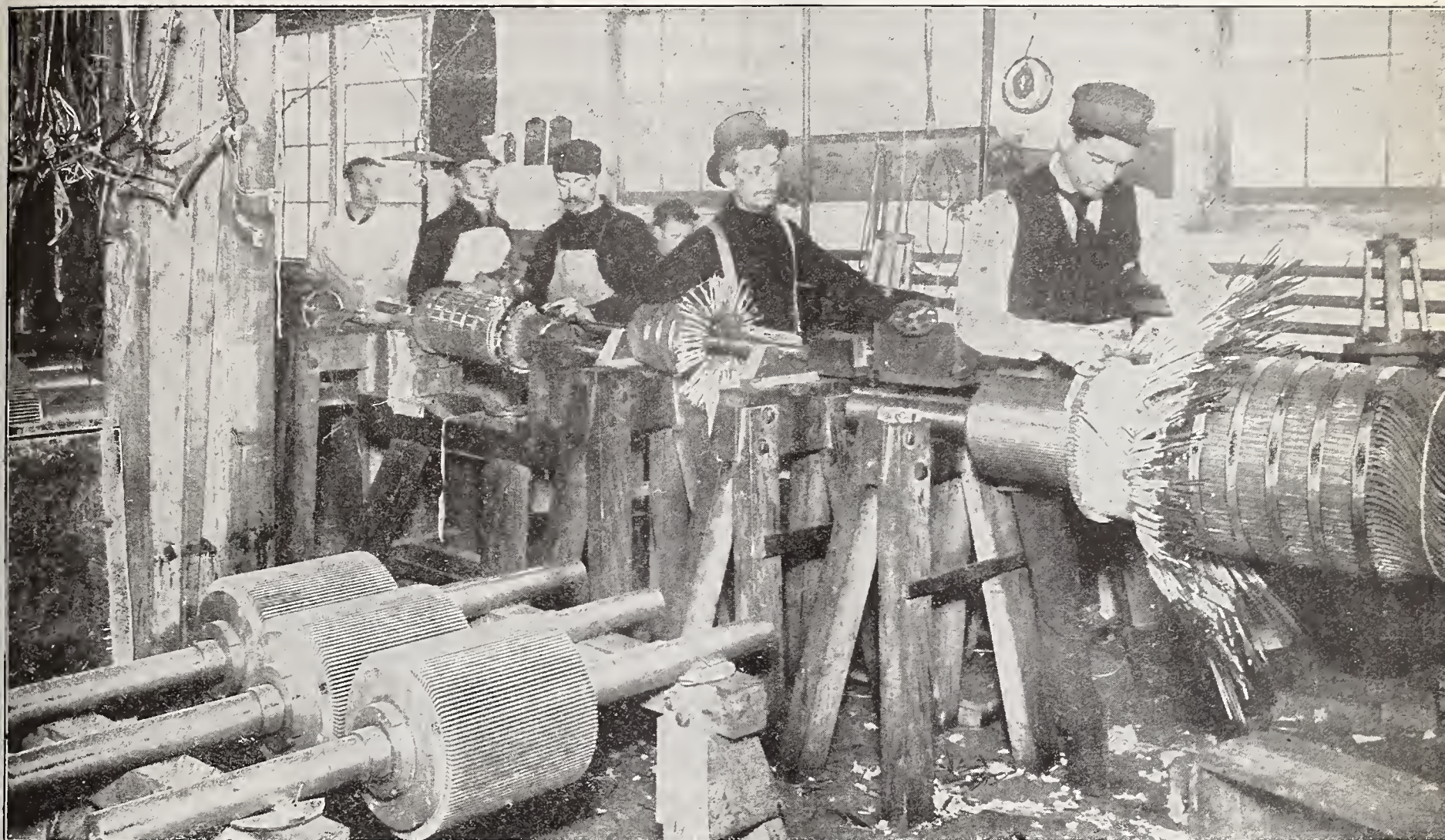
The Electrical Age.

VOL. XXII—No. 14

NEW YORK, OCTOBER 1, 1898

WHOLE No. 594

ELECTRIC LIGHT AND POWER.



Building Armatures. A Corner in Electrical Department.

DIRECT-COUPLED AND BELT-DRIVEN GENERATORS.

The dynamo has become an important factor in civilization. Electric lights have dispelled the slums of large cities. They add comfort to private and public life, and make deserted thoroughfares as safe as busy centres. The design and construction of a modern generator of electric power represents a degree of intelligence and experience in a crystallized form on the part of the builder which shows a deep-seated knowledge of the conditions of practice. The multipolar generator is, in this respect, a living example of the excellence attainable by adherence to the laws of design.

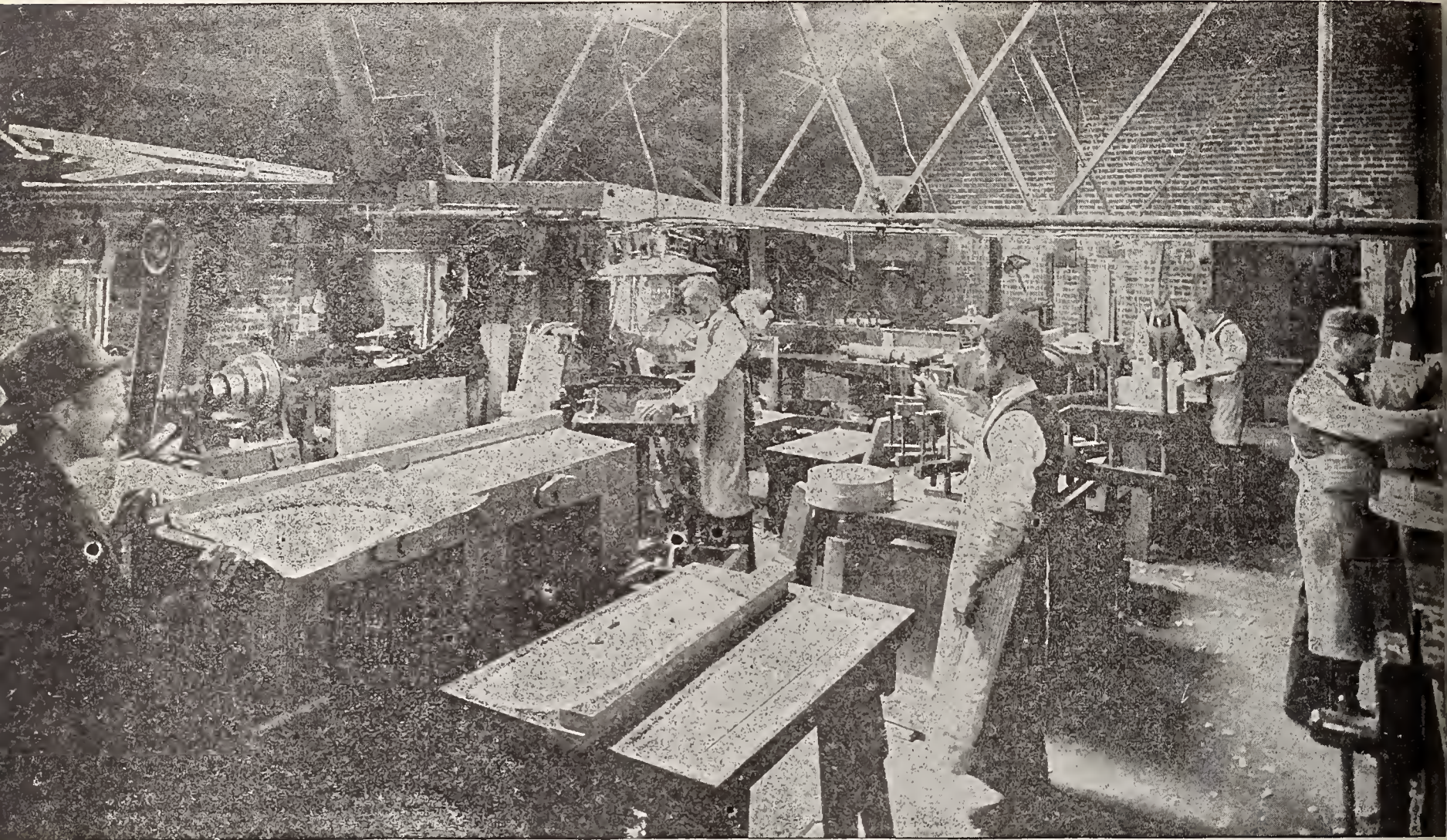
The American Engine Company, of Bound Brook, N. J., whose processes of manufacture in relation to dynamos and motors are thrown open to inspection on these pages, have produced a type of machine of the lightest, most efficient and durable character, from both a mechanical and electrical standpoint. They are constructed with yokes and pole pieces of very mild steel, which, by annealing, possess a high permeability. In adopting mild steel for dynamo construction, Mr. F. H. Ball, mechanical engineer and electrical expert, has obtained a metal whose efficiency, output and weight for the magnetic field produced is practically the superior of any other form of iron. The saving in copper by the use of a highly permeable metal and the reduction in cross-section, weight and floor space make it most desirable for dynamo construction.

The pattern department, in which the wooden shapes are prepared that are reproduced in metal, is commodious and well lighted. It is supplied with every convenience for quickly and thoroughly accomplishing any given work

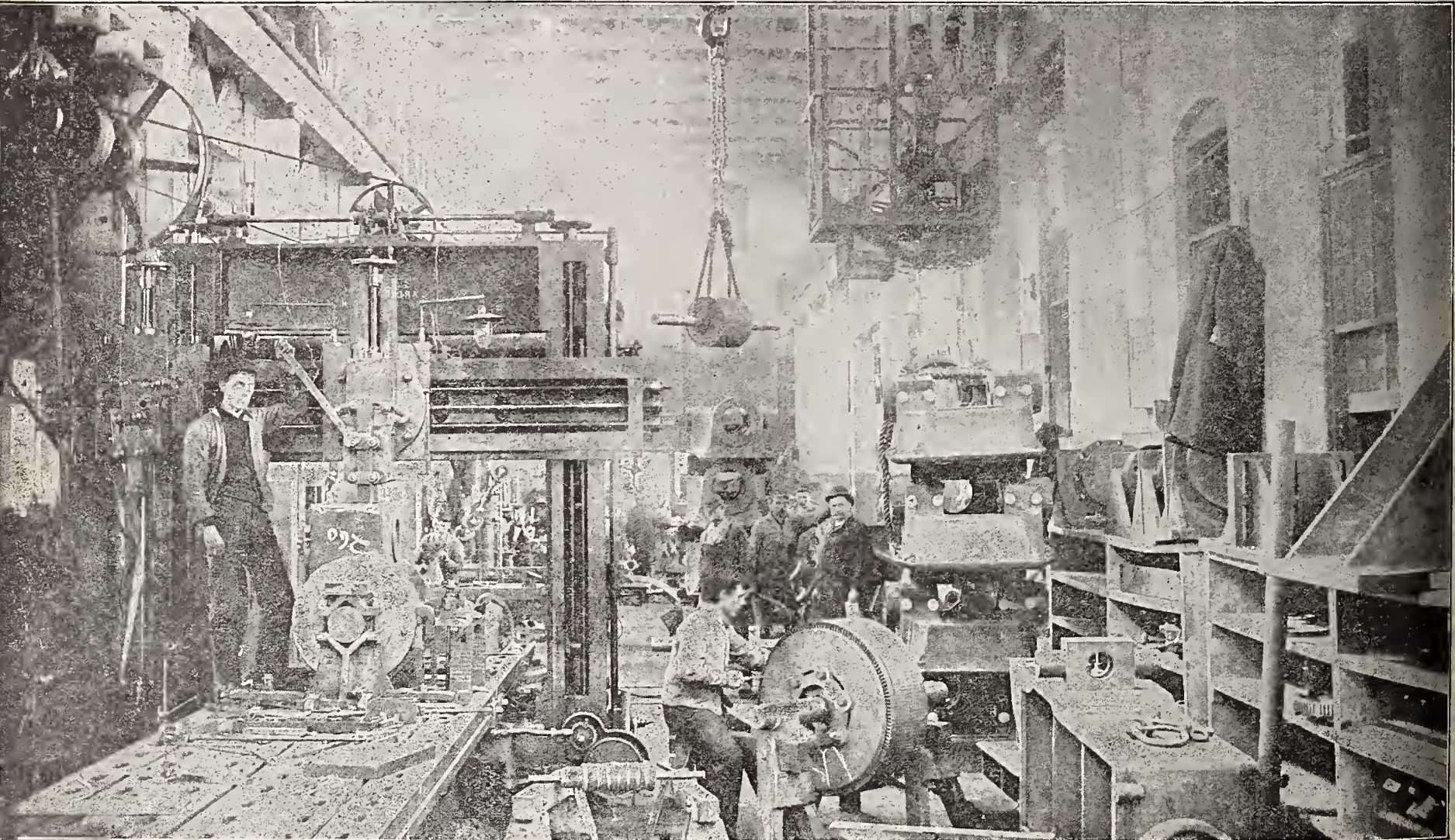
in any way relating to the frame or other parts. The machine shop, in which the castings and other parts are treated prior to assembling, is equipped with all modern conveniences in the line of labor-saving devices. Large planers, shapers, milling machines, engine lathes, drills, etc., assist in the rapid delivery of frames, armatures, shafts, bearings, foundations, etc., to the erecting, testing and winding departments. The lathe department for small work is one of the most complete in the country. The machinists employed there are thoroughly experienced in the details of dynamo construction and understand the meaning of good fitting and careful work. The forging department of the American Engine Company's shops is fitted with a steam hammer striking a six-ton blow at maximum power of delivery. The necessity of having a department of this kind for the renovation of lathe tools and the forging of different accessories is obvious. In a large establishment, such as that comprising these shops, the manager must be fully prepared to rehabilitate machines and renovate such parts as require immediate attention. In fact, the machine shop and forge room go hand in hand as a nucleus from which the assembling, winding, testing and pattern-making departments radiate.

The armatures of the generators have been carefully designed with regard to size, weight, number of turns, maximum temperature rise, etc. They are unique in being iron-clad; the protection thus insured removes an ever-present risk in other types of machines. Over-loading with these armatures does not produce any effects whatsoever within certain limits. The design has been

so carefully carried out as regards the possibilities of over-load that a liberal allowance has been made in the is in reality the design of an armature. Whatever may be the perfection of its other parts, irregularities in the arma-



A Corner in the Pattern Department.



A Corner in the Machine Shop.

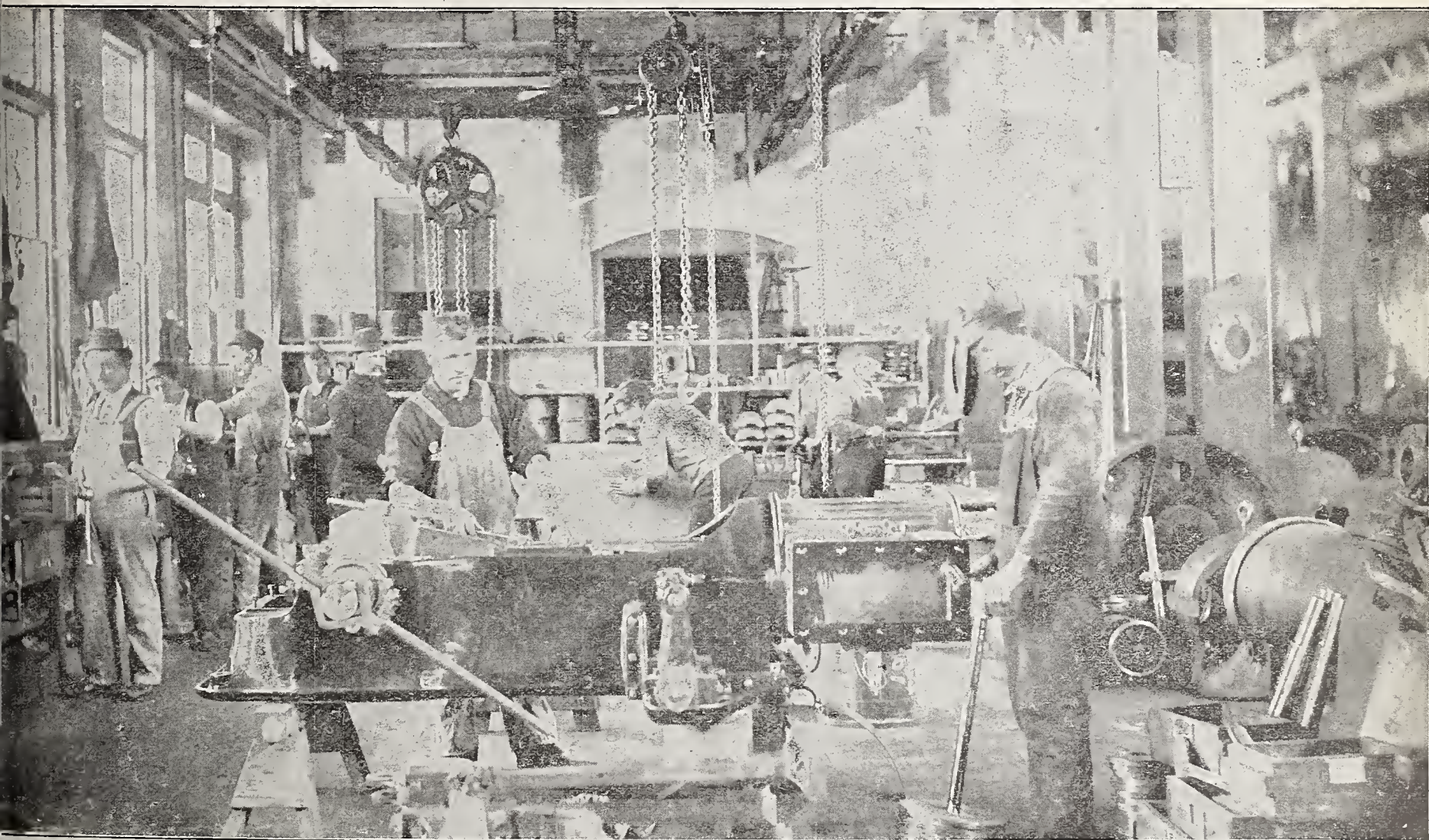
size of copper conductors and area of radiating surface to provide a large factor of safety. The design of a dynamo structure will cause a series of ineradicable troubles from the first hour it is assembled and operated.

The armatures of the four and six-pole generators are wound with form winding, as shown in illustrations. This

minimum of wire are among the advantages gained. The dead end wires are reduced to a minimum, and a low-re-



Erecting and Testing of Dynamos and Motors.



Erecting Engines.

system of winding produces results of the most satisfactory nature. Symmetry, compactness and the use of a

sistance armature results which, experience shows, is essential to success in electric lighting. Considerable

labor is saved in replacing a coil which may be burned or injured. This is, of course, a great feature in dynamo construction, as it recommends a machine with armature

shows a perfect balance in design. Nothing elaborate has been attempted, but the object kept constantly in view has been the production of a machine simple in con-



A Corner in Lathe Department for Small Work.



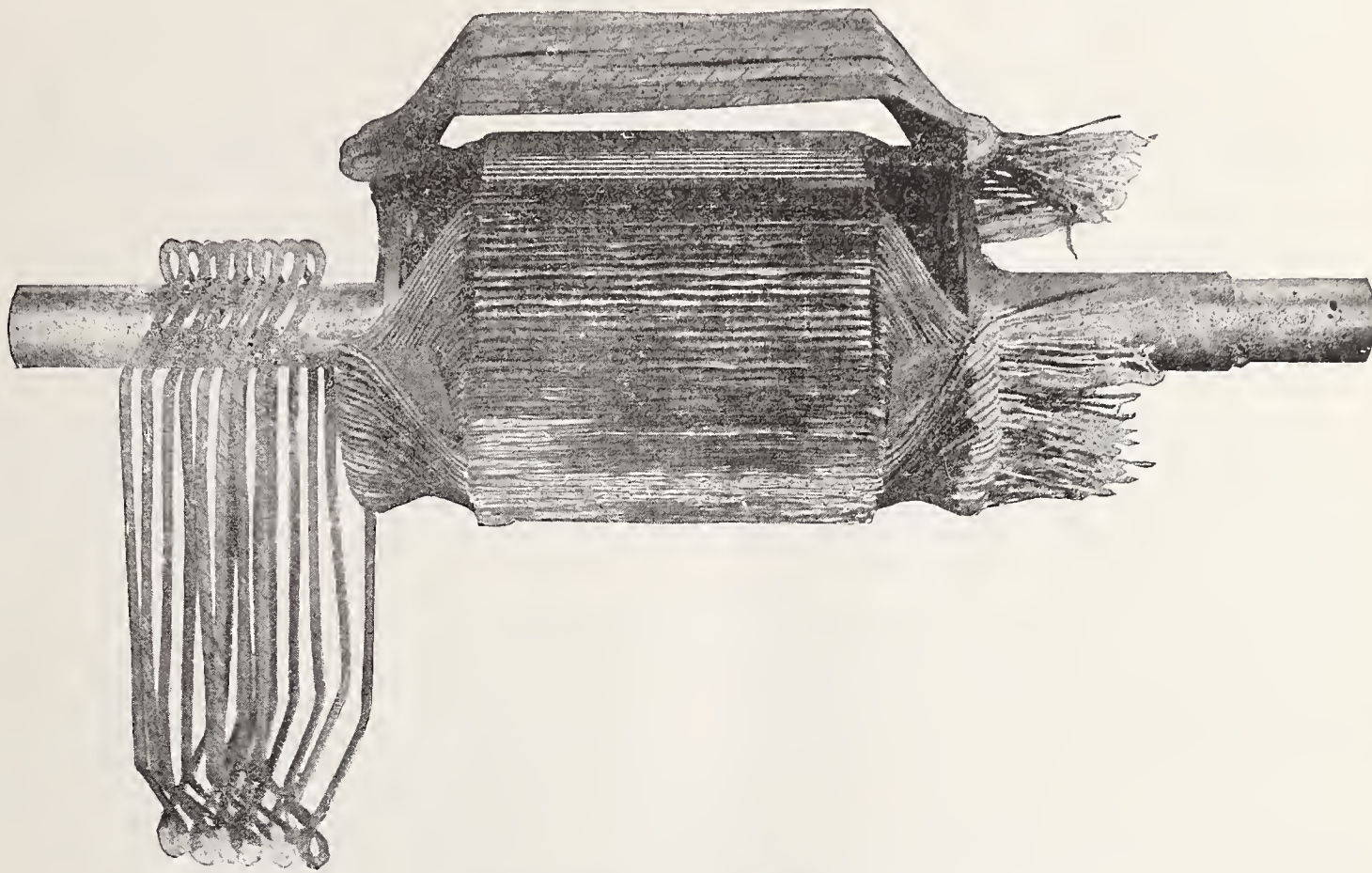
A Corner in Forging Department Showing Steam Hammer Capable of striking a 12,000 lb. Blow.

thus wound in preference to another. The configuration of these dynamos for belted work and direct connection

construction, high in efficiency, durable, and reliable for long runs.

In a machine of this type all that is thoroughly modern and up-to-date has been incorporated, leaving no room for criticism in this respect. Two noticeable features of construction are to be found in the form winding, which

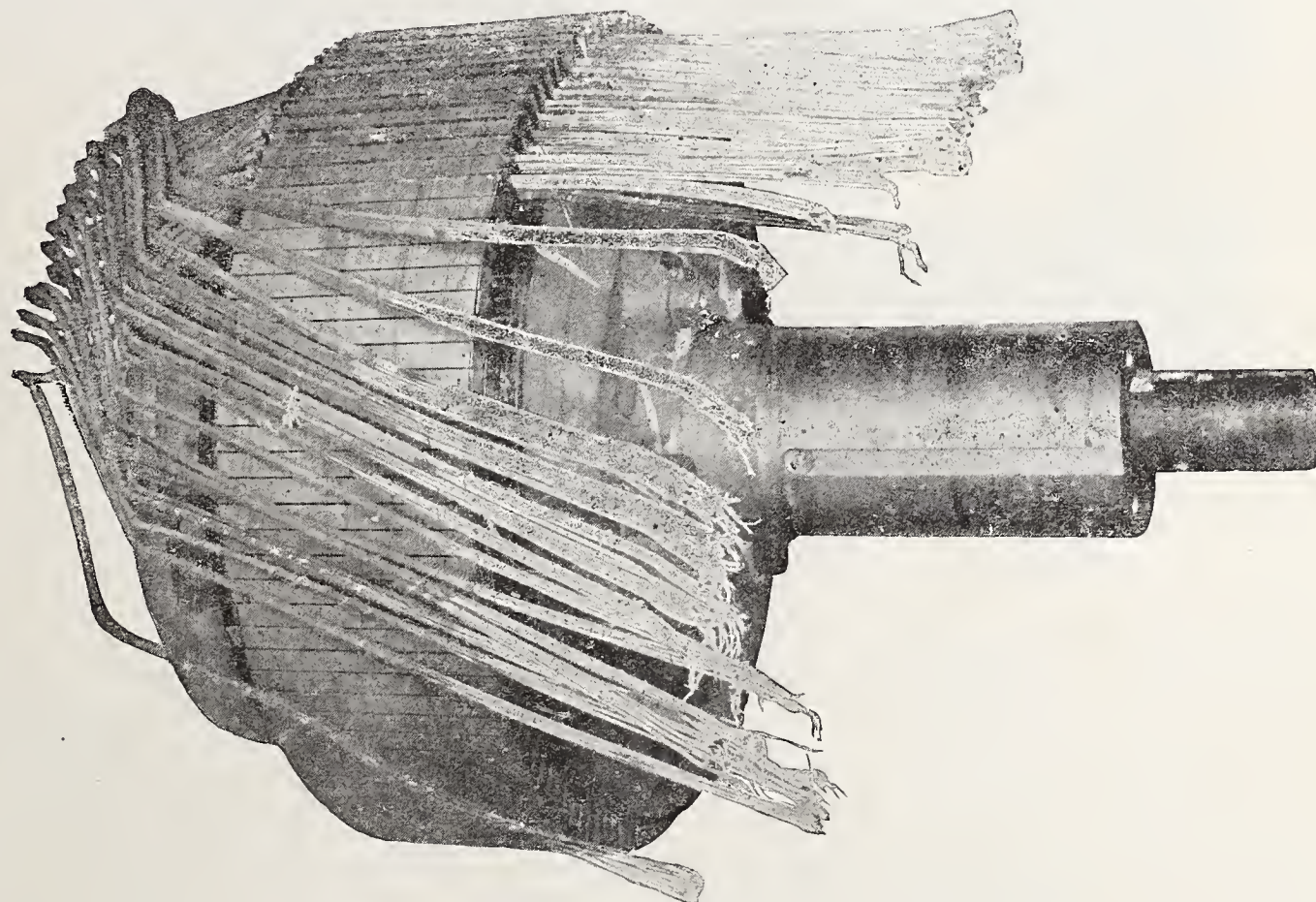
in sizes from 3 horse power to 125 horse power, and is wound for standard voltages. The standard four-pole type for belt driving runs in sizes of from 2 to 64 K. W. to 100 K. W., the speeds ranging from 1,600 r. p. m. to 425



Armature of Four Pole Generator in Course of Construction Showing Form Winding.

insures an effective circulation of air; and the fixed position of the brushes, from which sparking is entirely absent under all conditions of load. The direct connection of these generators to engines, including the building of

r. p. m. In the standard six-pole direct-connected generators, with iron-clad cylindrical-drum armatures, the sizes run from 25 to 125 K. W., and the number of revolutions per minute from 400 to 230. This includes sizes



Armature for Six Pole Generator in Course of Construction Showing Form Winding.

the engine, forms part of the work undertaken at this establishment.

The six-pole generator, especially adapted for direct connection, represents the acme of modern practice. From the moment of installation absolutely no attention is required except incidental oiling, etc. The standard four-pole type for belt driving or direct connection runs

of machines rated at 35, 50, 75 and 100 K. W.; the number of lamps that may be lit with each depending upon their watt consumption, the 125 K. W. machine lighting 2,500 50-watt lamps and 1,900 66-watt lamps of 16 candle power.

The American Engine Company have done well to regard the triple alliance of qualities embodied in the three

terms, *one unit, one firm, and one responsibility*, as the greatest assurance of success. The purchaser of electrical machinery can inquire further by addressing the above concern at Bound Brook, N. J.

ELECTRIC ILLUMINATING.

The Edison Company, in accord with its declared policy of reducing prices and encouraging the more general consumption of electric current, particularly for long-hour use, will replace its present schedules for both incandescent and arc lighting by the reduced rates scheduled below.

These rates give customers the benefit of the fact that electricity for long-hour use can be produced and sold cheaper than any rival illuminant.

The rates are as follows: For retail use, 20 cents per kilowatt hour (equivalent to 1 cent per 16 candle power 50 watt incandescent lamp hour, or 10 cents per standard arc lamp hour) for first hour's average daily use of the total lamp equivalent connected; 15 cents ($\frac{3}{4}$ cent or $7\frac{1}{2}$ cents) for the second hour; 10 cents ($\frac{1}{2}$ cent or 5 cents) for the third and fourth hours; and 5 cents ($\frac{1}{4}$ cent or $2\frac{1}{2}$ cents) for all use above four hours.

For wholesale use, with a guarantee of 2,000 kilowatt hours consumption each month and two hours average

FLASHES.

Tucson, Ariz.—The Western Union Telegraph office burned.

Allegheny, Pa.—New machinery is being added to the Allegheny City electric light plant.

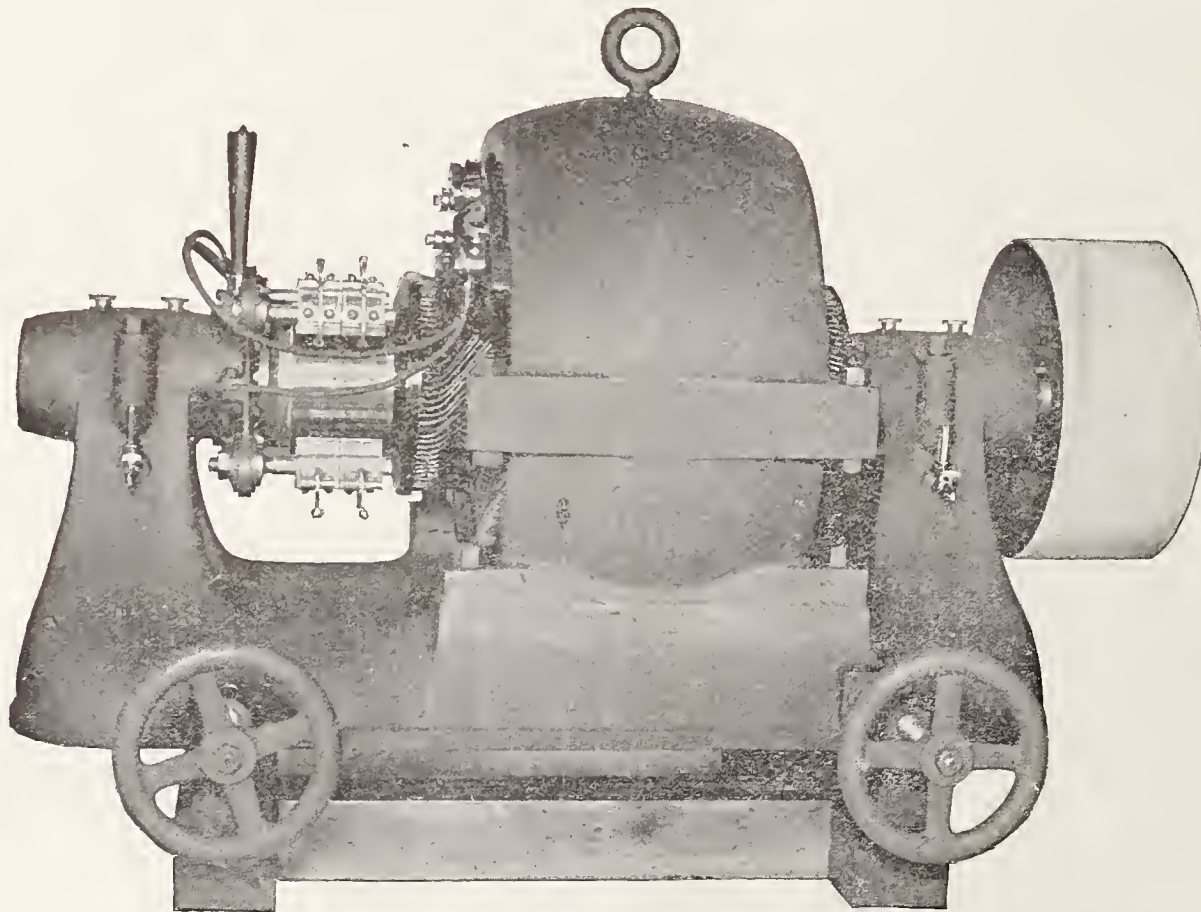
WATER POWER INSTALLATIONS.

LACHINE RAPIDS PLANT AND THE COST OF PRODUCING POWER FOR GENERATING ELECTRICITY THEREFROM.

By W. McLea Walbank.

In our own case you will notice it was necessary for us to spend about one million dollars (\$1,000,000) in hydraulic development. This million dollars is able to furnish us over twenty thousand (20,000) horse power, whereas it will be some time before we will be able to convince the public of the advantages to be derived from the use of electricity, which is no easy task, as anyone familiar with the subject will bear out.

The 5,000 horse power, from a commercial point of view, will have, for the present at least, to be charged with all the expense of the hydraulic development of over



The Multipolar Generator. Standard Four Pole.

daily use of installation, 10 cents per kilowatt hour for the first four hours' average daily use and 5 cents for all use above four hours; or, at the option of the consumer, the present wholesale or kilowatt rate of 10, 9, 8 and 7 cents per kilowatt hour for 2, 4, 6 and 8 hours' average daily use, with reductions for quantity, etc.

These prices cover both incandescent and arc lighting, and include renewal of incandescent lamps (not exceeding one 16 c. p. lamp for each 20 kilowatt hours), and the carbons and trimmings for arc lamps, but not first supply of lamps.

To encourage cooking, heating, etc., by electricity, household apparatus for cooking, heating and ventilating will, until further notice, be excluded in reckoning installation.

Natchez, Miss.—The city wants bids on the erection and equipment of an electrical plant.

20,000 horse power.

In estimating the cost of producing power from the Lachine Rapids, the writer does not take into consideration the cost of distributing power, for this would be the same in either case, whether the prime mover was a water wheel or a steam engine. He will therefore confine himself to the cost of developing water power and delivering that power on the bus-bar at the sub-station, exclusive of the generator. He will add the cost of transmission line from the source of power to the sub-station in the city, because this is directly attributable to water power plants, as it would not be necessary in the case of a steam plant, unless it were for transmitting power from a coal mine to a city, or following the practice laid down by the Brooklyn Edison Company, in locating their power house at a point convenient for obtaining coal and water at reduced prices, using high-tension transmission and converting by rotary converters at various sub-stations.

The Electrical Age.

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THE WEALTH INVESTED IN ELECTRICAL ENTERPRISES IN THE UNITED STATES.

The most important department of electrical engineering at the close of this century is electric railroading. Not more than ten years ago it hardly owned an existence. The total value of the investments in electric railways, in electric light and power companies and in the manufacture of electric appliances, including telegraph and telephone systems, amounts to \$2,000,000,000.00. Of this enormous sum about one billion dollars is invested in street railways; one half a billion in electric lighting, and the balance of half a billion in telegraph, telephone, power transmission and other minor fields of work requiring the use of electricity. It is quite certain that there will be an increase of five hundred million dollars more to the total representing electrical investments when electricity finds its way to the private homes, side streets and slums of large cities; when electric lights are used by the general public in place of gas, and electric heating has ceased to be a novelty, but has been accepted by those living in great cities as a necessary adjunct to home comfort.

An estimate of the real value of electrical investments is a practical impossibility on account of the rapid changes occurring in the fields of applied science. Yet taking today with its wealth representing electrical investments as a foundation, the two billion dollars may increase to four or five, or even six, in ten years to come. A calculation based upon known quantities would give only a natural rate of increase, but in vast commercial problems unexpected inventions may double, triple or quadruple the

sum invested. The past proves this. Why should we not expect it in the future? There are hundreds of inventions still inchoate, some in the hands of large corporations which will be developed, others whose date of development is indefinite for want of capital. The unknown factors certainly call for consideration and an estimate of the value of electrical enterprises might far exceed the two billions of dollars given as a conservative valuation. When the steam railroads have taken to electricity, and trucks and city vehicles are animated by it, and all homes are lighted and heated by its silent force, the wildest estimate of today may be the most conservative at that period of progress.

ELECTRICITY IN SHIPYARDS.

In large shipyards it is a common practice to drive the heavier machines by separate steam engines. These engines are of the non-condensing type and very wasteful. The tools that are driven by them are punching machines, heavy shears, large rollers, drills, etc. The coal consumption in a steam plant driving a collection of small steam engines is very great in comparison with the work done. Of late the adoption of electric power has shown more than ever before its peculiar fitness for this work. The lightness of the motor and the flexibility of an electric system are elements in favor of such an installation that none can gainsay.

Each individual machine may perform its functions when all are driven by electricity with an efficiency, speed and neatness that commends it at once for practical purposes. The electrical manufacturer is paying more and more attention of late to the design and construction of this class of tools. They are merely motors direct-connected to boring, planing, reaming, punching machinery, etc., yet are particularly interesting through the service they perform and the saving due to their employment. A large boiler operating a group of small steam engines will never begin to have the efficiency of an electric plant supplying a system of motors driving special tools.

The most useful of all motor-driven tools used in ship building is the counter-sinking machine. Then comes the boring and punching machine. By employing a portable milling machine driven by a motor the cutting of keyways in shafts, which used to take more than a day, is now accomplished in two hours. This, as a specific example, utterly opposes the idea that, because the first cost of an electric system is greater than a steam equipment, such a system must not be utilized. This is a mistake from every standpoint; the actual cost of installing a machine tool with motor attached cannot be greater than that of the same machine tool with steam engine attached. The difference cannot be found here. It cannot be found in the mains, as they are certainly cheaper to lay than steam pipes of the same length. But the difference in cost may be traced to the use of a dynamo and engine which are used between the boiler and electrically driven tools.

The time saved in using electric tools will in less than a year in a busy shipyard compensate for the cost of dynamo and engine; and during the second and third years of use accumulate a profit for the investor. For numerous purposes, unique in themselves, direct-connected tools and machines connected with shipyard work have proven superior to any other form of driving machinery installed in their place; in England electric capstans are in use, and electric elevators, or lifts, as they are commonly termed, built adjacent to a ship's sides while it is undergoing construction.

From a financial standpoint the saving due to a well installed electric system makes it highly commendable, and the industrial and commercial practice and experience speak highly in its favor.

There will also be included the step-down transformers to bring the pressure equal to that required for local distribution, namely, in the neighborhood of 2,000 volts.

He will also charge the water power with the drop or loss in power from the rapids to the sub-station.

The writer therefore considers, in justice to the Lachine Rapids plant, it would be necessary to give, first, the cost per kilowatt per year for the portion of the plant at present installed and connected to generators ready for operation, and, second, what the cost will be per kilowatt per year when the whole water power development is in operation.

First—The total cost of water rights, dams, hydraulic machinery, power house, transmission line, step-down transformers, etc., is \$957,200.

Power developed, 4,000 kilowatts at the generator. Allowing 10 per cent loss, there will be delivered at the sub-station bus-bar 3,600 kilowatts, which is equivalent to \$263.83 per kilowatt, capital cost.

This, at 6 per cent., would be equivalent to..... \$15.95 per K. W.

Depreciation of \$300,000, which will more than cover the cost of that portion of the plant subject to depreciation, rated at 5 per cent. and spread over 3,600 kilowatts, would be equivalent to.... 4.17 per K. W.

Operating expenses, including labor, repairs, insurance, amounts to \$10,275 per annum, which, divided into 3,600 kilowatts, is equivalent to..... 2.85 per K. W.

Making a total cost per kilowatt on a twenty-four hour day basis, per year..... \$22.97 per K. W.

Second—The total cost per kilowatt with the whole water power plant in operation.

Before giving these figures the writer would like to explain that the figures herewith quoted are reliable for the cost of the completed plant, inasmuch as the same is at present under contract with reputable firms, the Lachine Rapids Hydraulic & Land Company having a limited time in which to order the works completed.

The total capital cost with seventy-two wheels installed will be \$1,113,273.

Power developed after deducting all losses will be 13,500 kilowatts at the sub-station bus-bar, equivalent to \$82.46 per horse power capital cost, which, at 6 per cent., represents (per annum)..... \$4.95 per K. W.

Depreciation per kilowatt will equal... 1.68 per K. W.

Operating expenses, including labor, repairs, oil and waste and insurance, if taken upon the same basis as already existing, will amount to \$20,453, equivalent to 1.51 per K. W.

Making a total for a twenty-four hour run per annum of..... \$8.14 per K. W.

It will be noticed that the operating expenses, as well as the depreciation per kilowatt, in the latter case is very much reduced, and it is a remarkable feature how constant our operating expenses are, even at present, being practically the same with full load as with no load.

In connection with these figures it might be stated that coal used in Montreal and vicinity is what is known as Nova Scotian coal and costs \$3.50 per ton for run of mine.

The writer would also draw your attention to the fact that the capital cost cited in each of the foregoing cases includes money paid for real estate, of which the company owns over some eight million feet, fronting on the rap-

ids, intended at some future date to form the site of a suburban town, and which it is hoped and expected will return the money expended in developing the water power above referred to.

Conclusions.

From the foregoing the writer trusts that he has shown that where reliable water power can be obtained within reasonable distance from power centres it can be made to produce cheap electric current, to say nothing of the great advantages the city must derive therefrom, not only commercially, but viewed from a sanitary standpoint as well, as the use of electric power thus generated is the best smoke consumer yet invented.

NOTES FROM DISCUSSION OF PAPER.

In the discussion it was stated that the cost given in the paper was based upon the possible output of the plant, independent of the number of hours it was used. The capital stock was a certain amount and there was a certain capacity in electrical generators, and by dividing one into the other, you would get the amount it cost per horsepower. They would sell power, Mr. Walbank said, to anyone who wanted it, no matter for how short a time.

Mr. Ferguson said that to offer a comparison between a water-power station and steam plant, he would offer some figures based on the Harrison-street station of the Chicago Edison Co. The cost of station, including the transmission line, was \$1,200,000; the interest on that amount would be \$72,000; total cost of operating at the switchboard of that station \$77,000 per year; the two latter items added together making \$149,000. Taking the depreciation that Mr. Walbank gives, we have a depreciation of \$20,000, making the total operating cost \$169,000. The total maximum capacity of that station is 7,000 kilowatts, so that the cost per kilowatt in that station would be \$24, as compared with \$22.90, as stated by Mr. Walbank; so that the difference in cost in generation of a water plant and that of a first-class steam plant is very light. Coal in Chicago is \$1.12 per ton.

Mr. Walbank stated that his coal charge was \$3.50 a ton.

Mr. Ferguson said that it should be known what the load factor of Mr. Walbank's station was, because the figure of \$10,000 is proportional with the output, or it will vary with the output, so that the load factor is now only ten per cent. It was hardly fair to compare the cost he had presented with a system having a load factor of 25 per cent. If it cost only ten per cent., then, of course, the output per kilowatt would be less, and the figures would be still more favorable to the steam plant.

The next paper was on "Transformer Economy," by Professor Goldsborough, of Purdue University, Lafayette, Indiana.

Previous to the discussion on this paper the President appointed the following gentlemen as the Committee on Nominations—A. M. Robertson, Minneapolis, Minn.; James Dee, Houghton, Mich.; James I. Ayer, Boston, Mass.

ALTERNATING CURRENT MACHINERY.

"TRANSFORMER ECONOMY."

By Professor Goldsborough, of Purdue University, Lafayette, Indiana.

Continued.

The ageing of transformer iron does not increase at a constant rate with the time. The rate of increase diminishes as the service continues, but the increase may go on indefinitely. Until the use of non-ageing iron becomes more generally possible than at present, it is prob-

able that it will pay to replace the majority of the transformers placed on the market by new ones every few years.

It is our present intention to inaugurate next fall a series of one-year ageing tests under continuous full-load conditions of a representative number of transformers that will be built during the present summer by the manufacturing companies who are interested in having these points thoroughly ventilated, and I trust to be able to publish a record of fine performance in this respect at the time of the completion of the tests.

The correct insulation of transformers is another important point that should be considered by the central station manager. Like many of the problems with which we have to deal in the effort to make the transformer a commercial success, this one seems to be subject to a wide variety of opinion. The oil insulation of transformers has deservedly come into great favor, and where care is taken in the selection of the oils used and in the proper design of the transformer case, high protection is secured. Oil insulation under all circumstances does not, however, secure to the purchaser the protection which he feels he is paying for. The claims that are usually made for the superiority of oil insulation, to wit, that it serves to preserve the insulation from oxidation, reinforces the resistance of the insulation to puncture, reinsulates punctures after the passage of the discharge and facilitates the diffusion of the energy liberated as heat in the core and coils, can in general be readily substantiated.

My experience, however, is that these statements must be regarded as having only a relative bearing upon the subject. Under certain circumstances the insulating value of an oil will be very materially impaired. We are told that transformers will last indefinitely when insulated with oil, whereas without oil the insulation will be so deteriorated after five or ten years that the transformers should be replaced, and it may therefore be a matter of surprise that the insulating qualities of the oil itself are ever seriously diminished. As a matter of fact, experiment shows that the insulating properties of the oils commonly used in transformers are increased, as their temperatures are raised up to about 110 degrees C., and that if allowed to cool they will not lose their augmented power of resisting a disruptive discharge.

This much might be said in favor of oil insulation, in view of this two or three-fold gain in insulating power, were it not for the fact that a continued heating of the oil for any considerable length of time changes the oil to such an extent that on being cooled its break-down value will be only about one-fifth of its original value. And therefore an oil-insulated transformer that will stand an insulation test of 10,000 volts when new, may break down under a pressure of 2,000 volts after having been in continuous service for a considerable time. Conditions such as will produce a result of this character are not likely to occur in the case of modern transformers, as the increase in the temperature of even the poorest transformers rarely exceeds 70 degrees C. I have, however, met with cases in which excessive heating has resulted when the transformers were kept continuously in service, and I have also in mind a case in which a good modern transformer was so situated above a tin roof and in a position where it was protected from any breeze that might be stirring, that, when the sun played upon it, its temperature reached perfectly distressing values.

What I have said will serve as a hint of how not to handle a transformer, and the importance of selecting proper places for the location of transformers.

If you will look carefully into the matter you will find that not all of the burnouts are due to faulty construction on the part of the manufacturer. It is my experience that the contractor has been in fault in a fair proportion of the cases in which the transformer and service installation has suffered.

For all commercial purposes the best oils will be found to give thoroughly satisfactory results and retain their in-

sulating properties unimpaired so long as the maximum temperature of the oil does not exceed sixty or seventy degrees centigrade. In making a station test of a transformer, if the rise in the temperature of the windings, as measured by the increase of resistance method, does not exceed fifty degrees centigrade, after a ten hours' run at full load, the transformer may be passed as satisfactory in this respect.

In connection with oil insulation it must be remembered that its efficiency as an insulating medium is impaired by discharges in the oil. One of the foremost claims made in behalf of oil insulation is that it will flow in and fill up a rupture in the insulation of the coils. Every electric discharge that takes place through the oil, however, disintegrates and breaks up the normal structure of the oil, and causes carbon and other conducting compounds to form. These will rapidly multiply if the discharges are at all frequent, and will destroy the insulating properties of the oil.

As a case in point, and I presume you may know of other similar instances, I want to call your attention to a very good example of what good practice vs. bad practice will accomplish.

There is a city in the West in which the conditions under which electricity is supplied for incandescent lighting are somewhat unusual. There are two companies interested in the business, and both employ the alternating-current converter system of distribution. The plant that is operated by the older company was installed about six years ago, and its equipment has grown slowly from year to year as business expanded. Its development has followed the waves of evolution modifying electric lighting practice within this period with a lag factor approximating 90 degrees. The plant has some strictly modern machinery, but much of the line equipment is old. A number of its transformers have been burnt out on account of defective insulation, some have been burnt out by lightning, and some have shown their efficiency by getting so hot when switched in on an all-day schedule under light load, that the "oil used to insulate them boiled up and over and ran down the outsides of the cases."

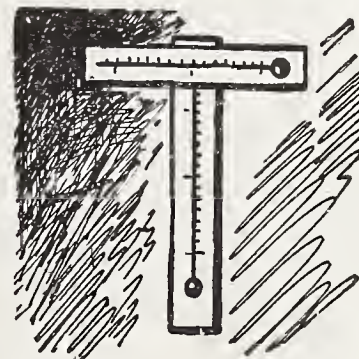
It is needless to say that in the latter type of transformer the hysteretic losses were considerable; the transformers were, however, manufactured by a firm of high commercial standing.

The lines of the old company are not protected by lightning arresters except where they enter the station, and the secondaries are not grounded.

(To be continued.)

ELECTRIC PUMPING MACHINERY.

ELECTRIC PUMPS.

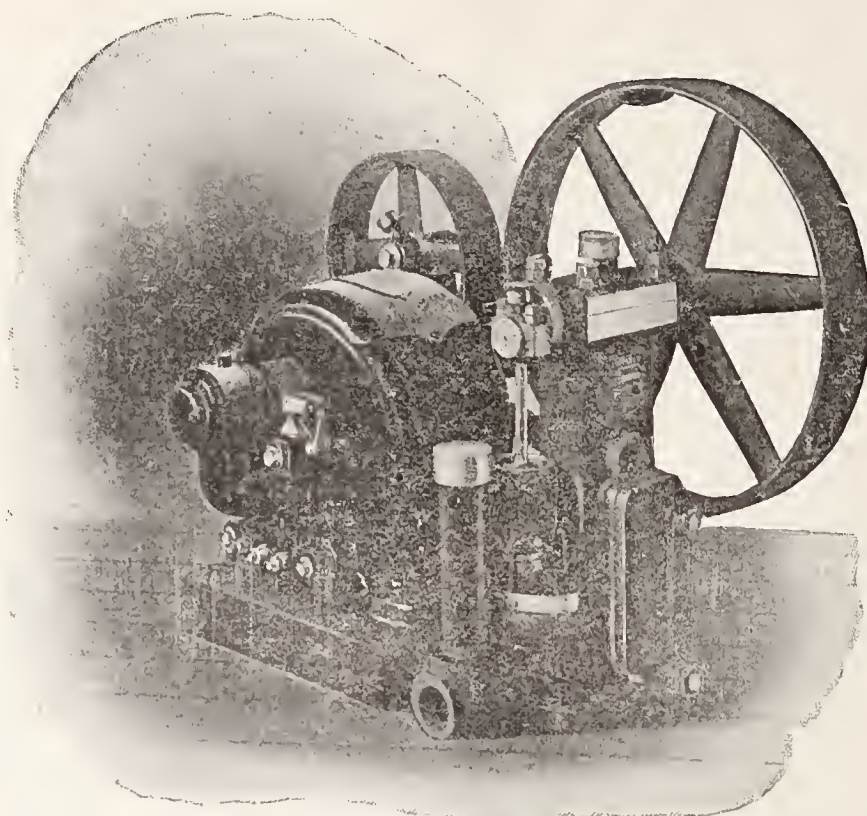


THE manufacture of pumps dates back to a very early period in history. To avoid the labor of raising water to a given height, Archimedes invented his spiral. A pipe of helical shape, with one end dipping into the water, the whole inclined in position and rotated, performed the function of a pump. But there is no real substitute for a pump, and in the use of one, unless a critical selection is made, power may be wasted and many difficulties experienced. The pump is a purely mechanical device, but its efficiency and smoothness of operation are two features which must never be lost sight of during their construction.

The Worthington pumps are known all over the world for their success, durability and finish. In connection with a motor, the application of electricity practically per-

fects an appliance to a degree hitherto unreachd. The Worthington electric pump is used for many purposes, including the filling of house tanks, the reservoir tanks of office buildings and such purposes where the raising of water to a higher level is to be quickly and conveniently

is uniform and regular. The power consumption, depending upon the work done, reaches a maximum of one horse power and a minimum of one-quarter horse power. The differential plunger of this pump gives the motor steady work. It therefore operates under the best con-



The Worthington Pump.

accomplished. These pumps are made in two sizes, one of 500 gallons' capacity per hour, the other of 250 gallons' capacity per hour. The motor is not connected to the pump by gearing, but is belted to it. Noise is therefore

ditions, and the pump, as a whole, represents, from an economical standpoint, one of the best combinations on the market.

The Worthington electric pumps are manufactured by



Installations of Worthington Pumps.

absent while the pump is operating. The mechanism of the pump is such that the plunger, which is differential in action, operates equally well on the up and down stroke. The pump shaft is driven at the rate of 200 revolutions per minute, and in consequence of this the flow of water

Henry R. Worthington, at Van Brunt and Rapelyea streets, Brooklyn, N. Y. Offices and agencies have been established in all the principal cities of the world, as well as of the United States.

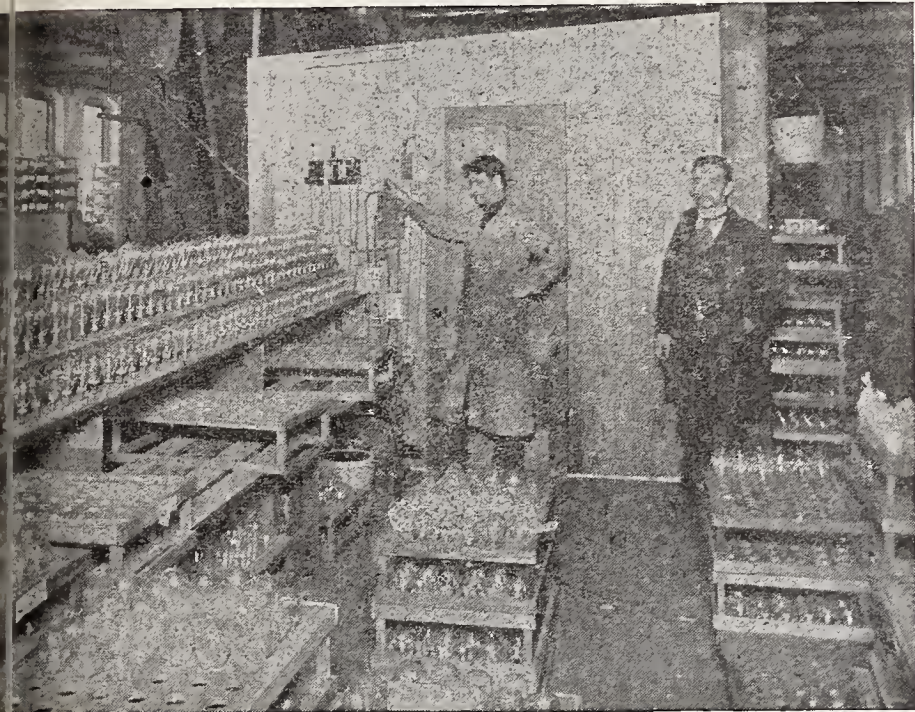
The demand for electric pumps has become so heavy

within the last few years that it is recognized to-day as a field of work distinct in itself and of increasing importance.

STRAY CURRENTS.

The cost of extra fuel required to light a train of ten cars by an English system of dynamos driven from the axles of the cars at ordinary speeds is one-half pound per train mile, according to the "Railroad Gazette."

Mr. S. N. Fleming, a locomotive engineer at Hopkinsville, Ky, has patented an electric train-blocking system of rather peculiar character. He proposes having all



Lynn Incandescent Lamp Co. Testing Lamps Before Shipping.

locomotives equipped with a magnetic bell, electric battery and two trolleys, which make contact with a third rail. One merit claimed for this system is that the locomotive engineers miles apart can signal to each other.—Ex.

Aluminum conductors are used for the first time in long-distance electric transmission in carrying the current from the Snoqualmie power plant to Tacoma and Seattle. The line to Tacoma is 47 miles long, and Seattle is reached by a 12-mile branch. The wires are Nos. 2 and 3 B. & S., the composition being aluminum 99.3 per cent., iron 0.25 per cent., silver 0.3 per cent., and this metal alloyed with 1.5 per cent. of Lake copper.—Exchange.

In regard to the competition of electric lines, President Tuttle, of the Boston & Maine, believes that the steam roads will have to bow to the inevitable and surrender a portion of their suburban traffic. No matter, he says, how the matter may be viewed, the street railway within certain limits has now and will continue to have the advantage over the steam roads. The latter may improve their service as much as they can, but they will find eventually that they cannot compete with the trolley lines, which insure service that the steam roads cannot give, and the latter will therefore have to abandon suburban business within four or five miles of the city. They will have to develop their long-distance service, and can make improvements within a zone of from six to twenty-five miles, in addition to lowering the longer distance rates. In this way suburbs will be extended.—Ex.

Travellers are soon to be carried to the top of the great St. Bernard by electric power. Power will be taken from the numerous mountain streams of the great St. Bernard. The enterprise is backed by English capital.—Ex.

The longest span of telegraph wire in the world is said to be in India, across the river Kistna. It is over 6,000 feet in length.

BUSINESS CHANCES.

Albany, N. Y.—The American Telephone and Telephone Company, of New York City, increase of capital stock from \$20,000,000 to \$25,000,000.

Albany, N. Y.—The Commercial Cable & Telegraph Company, capital increased from \$100,000 to \$500,000. The debts and liabilities of the company amount to \$15,000,000.

INCANDESCENT LAMP MANUFACTURE.

STREET-RAILWAY LAMPS.

The severest test possible for an incandescent lamp may be found in street railway service. A new railway lamp has been perfected by the Lynn Incandescent Lamp Company, of Lynn, Mass. The strength of the filament, uniformity of light and efficiency of this lamp make it of the utmost importance to street railway companies. The current consumption of this lamp is a fixed quantity. By securing this feature of manufacture these lamps, when in service and connected in series, burn equally well. It is simply a matter of experiment for street railway concerns to discover the superior qualities of this lamp. Its long life and power of throwing light equally in all directions is earning for it a national reputation.

The Lynn Incandescent Lamp Company make a specialty of renewing burned-out lamps. This unique industry is of great advantage to consumers of incandescent lamps. By paying a nominal sum, the filaments of old lamps are replaced by new ones and the bulb and base cleaned as well as new. The requirements of pressure, candle power and wattage are carefully observed. The annual expense to large electric light companies, street railway corporations and private plant owners amounts to hundreds of thousands of dollars for lamps. A considerable percentage of this expense is saved by renewing them on the plan offered by this company. This can be ascertained by writing for price lists and literature bearing on the subject.



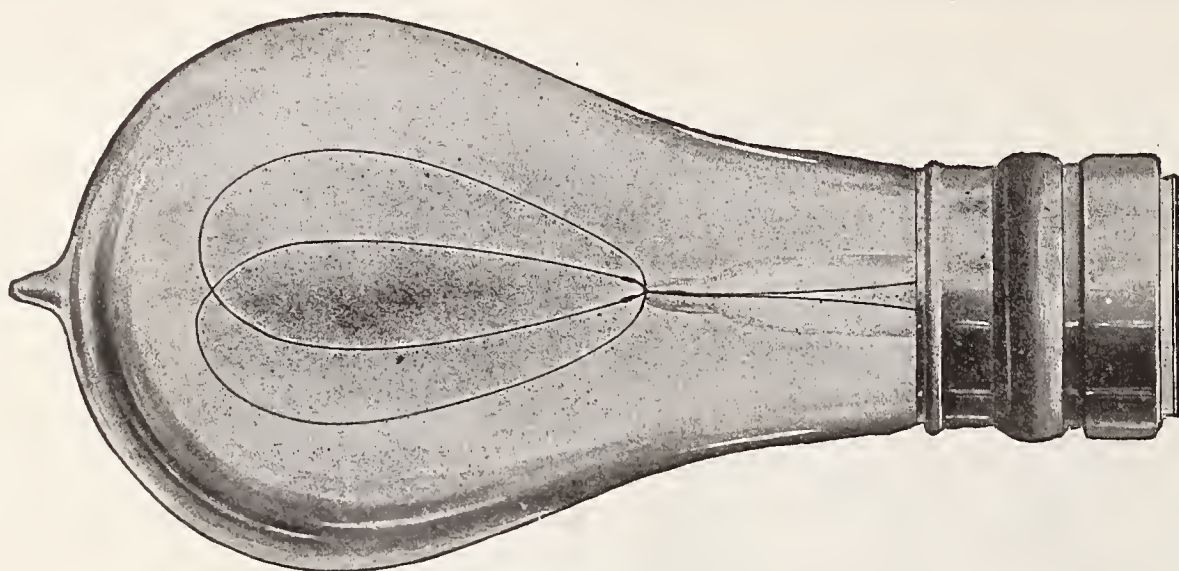
Lynn Incandescent Lamp Co. Room Where the New Carbons are Put Into the Bulbs.

The extensive plant and complete equipment of the Lynn Incandescent Lamp Company enables them to operate commercially under the best conditions. They have not confined their work to any rut, but are broadening it. They make a very serviceable and successful 220-volt lamp, and in other respects have made progress in this

particular field of work. One of the direct proofs of their enterprise lies in the fact that they are the first to renew burned or deteriorated lamps. They also sell a renewed railway lamp which is only half as expensive as the new lamp above described.

bend tension spring towards dog, sufficient to stiffen to requirement. Return parts as before, screw all screws tightly home."

Manufacturers of electrical goods seeking a market for



Lynn Street Car Lamp.

STREET RAILWAY APPLIANCES.

THE WILSON TROLLEY-POLE CATCHER.

When the trolley pole slips it is likely to damage the overhead wires. In order to obviate this difficulty, Wilson, Thomson & Company, of Brooklyn, N. Y., manufacture the Wilson trolley-pole catcher, by means of which the pole is instantly caught after the pole leaves the wire, and the damage it is likely to inflict is thus entirely prevented.

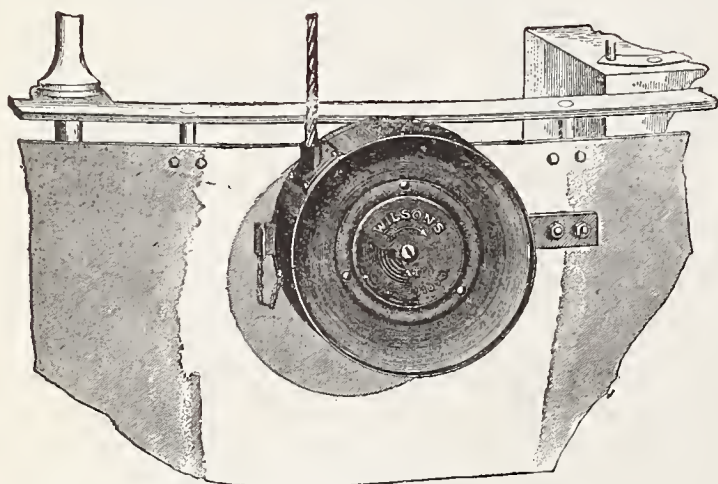
As shown in illustrations, it consists of a reel regulated by a long clock spring which takes up the slack rope. The internal mechanism shows that the sudden movement of the trolley pole makes the mechanism rotate, and centrifugal force causes the device to grip or catch. In fact, it is called a "catcher" and is attached to the car on the dasher. The catcher is supplied with number 7 or 8 "Sampson" trolley cord on reel and two

their products will be interested in the following announcement:

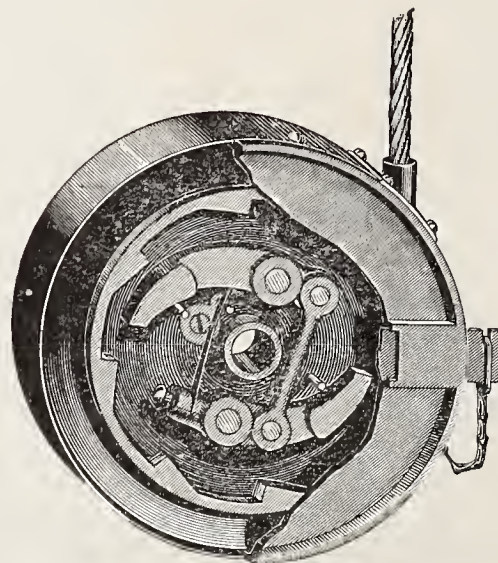
The American Equipment Company, 203 Broadway, City, will, about December 1st, put one or more standard cars for electric railways in service on the principal roads in prominent cities of the United States, to practically demonstrate the most approved apparatus for electric railways.

Manufacturers of street railway goods having anything they would like to exhibit in this most practical manner to managers of electric roads should communicate at once with the above company, and they will arrange to exhibit the same at a nominal expense, compared with the benefit that the manufacturers will derive from such an exhibition.

The car will be accompanied by a person experienced in the introduction and exploitation of railway and electrical apparatus and supplies, who, being in touch with officials of the various roads, will have excellent facilities



Wilson Patent Trolley Pole Catcher



"Catcher" Showing Internal Mechanism.

dash attachments, with bolts for fastening. If the catcher is oiled once a week it will remain in good working order. The device may be so adjusted that the pole cannot rise six inches above the trolley wire after slipping.

The following directions are valuable: "To open, to repair or clean catcher withdraw cord, place catcher on its back, retard unwinding of reel spring by pressure of fingers on face of reel, unscrew set screw, turn catcher on its face, lift case, and case and reel will separate. To stiffen tension spring (if catcher catches too quickly), unscrew tin plate from post of tension dog, lift off dog and

to further the exhibitors' interest. Manufacturers not already represented in New York can make arrangements whereby the American Equipment Company will represent them in New York and adjacent territory. Mr. O. S. Burr is the president of the company.

Luraville, Fla.—The Luraville & Suwanee River Telephone Company has been incorporated by Thomas I. McIntosh, of Luraville; Sidney V. Hough, Lancaster, Florida; L. T. Boatright, of Live Oak, Fla.; William T. Dees, of Mayo, Fla.; for the construction and operation of a telephone system. Capital stock, \$3,000.

TELEPHONIC.

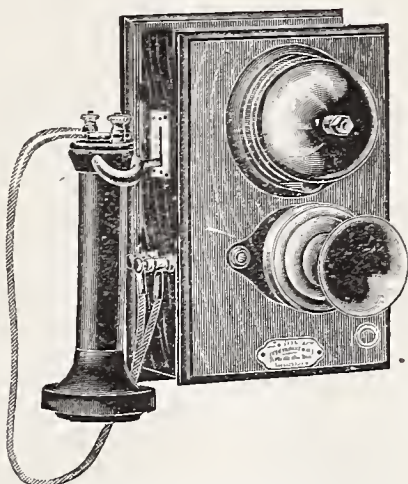
INTERIOR AND LONG-DISTANCE TELEPHONES.

The telephone is an instrument which responds so admirably to the influence of the slightest vibration that, in spite of the millions in use, it is still regarded as a marvelous invention. A perfect telephone is one which

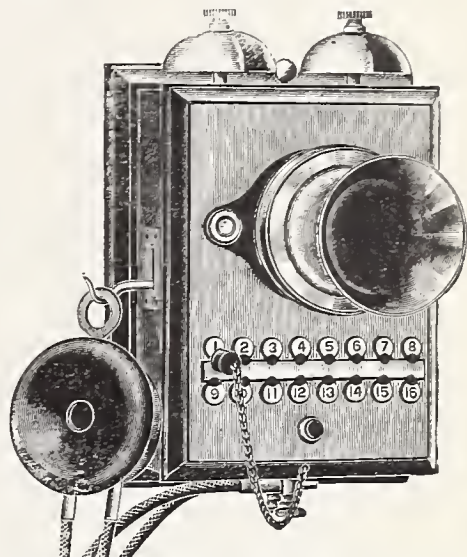
Greenwich street, New York City, manufacturers of interior and long-distance telephones, manufacture the "Twentieth Century" high-grade telephones, which, in clearness of sound, cannot be excelled. The Central R. R. of New Jersey say they are superior to the Bell, and state that with them they have been able to speak through a submarine cable to New York. Interference and induction of any kind are entirely absent, although with other



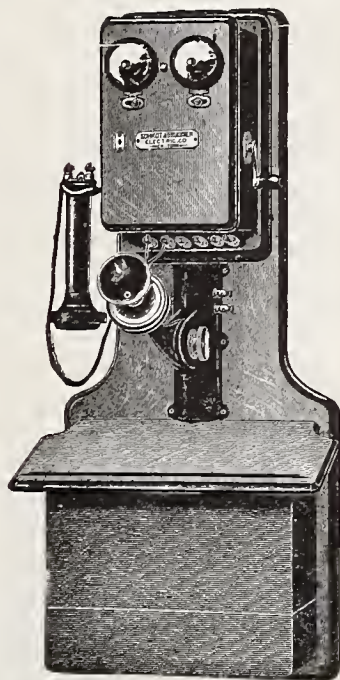
Desk Set with Double Pole Watch Case Receiver.



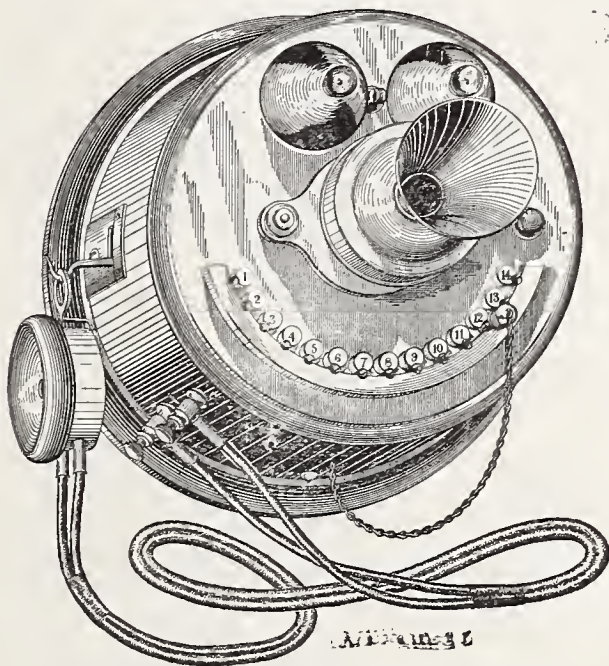
Battery Call Telephone.



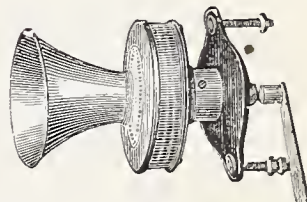
Smallest Intercommunicating Wall Set.



Magneto Call Telephone with Long Moveable Arm.



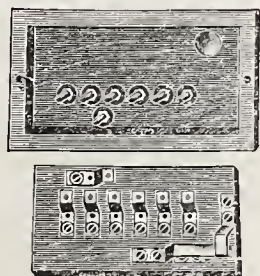
Smallest Intercommunicating Wall Set. Round Form.



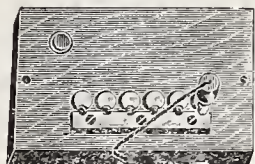
American Coal Grain Microphone.

transmits and receives the voice of an auditor with clearness and precision. Blurring of sounds should be entirely absent, and a pronounced audibility must be possessed by

phones speech was imperfect. The transmitters of the Schmidt & Bruckner Electric Company are built on the same principle as the "Ericsson," differing in the use of



Interior Intercommunicating Plug Switch.



Intercommunicating Plug Switch.



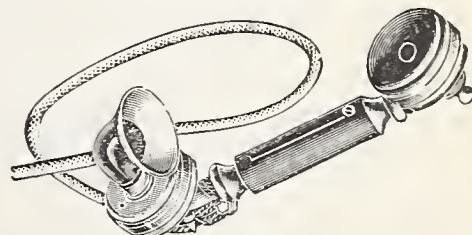
Long Handle D. P. Metallic Case Receiver.



Standard Long Handle S. P. Receiver.



D. P. Watch Case Receiver.



Combination Micro-telephone.

in order to make its serviceability and convenience pronounced.

The Schmidt & Bruckner Electric Company, of 209 a solid gold plate in lieu of one that is merely plated. In the "Ericsson" transmitter the plating becomes worn, and the transmitter rapidly deteriorates.

To testify to the superior quality of these instruments, we may state that the concern started business a year ago with only two men and are now employing over forty-five. Messrs. Schmidt & Bruckner are old Western Electric men; Mr. Schmidt occupying the position of foreman in the shops, and Mr. Bruckner that of inspector.

The interior intercommunicating system of this firm is one of the most complete, compact and practical outfits on the market. In making connection for calls on a numbered call, either on the face of the transmitter box or on the switch box, with the desk set no flexible cords are used, but this is effected by a plug on the one main line by connecting up a post on the desired call or number wanted. These connections take up very little room. They can put twenty-four calls or numbers on the face of a transmitter the size of a Blake box. The surface of the box is shown in the illustration, with transmitter and hook for receiver. They use imported granular carbon in all their transmitters, and as far as the receiver is concerned, its magnet is capable of lifting four and one-half pounds, being superior in this respect to the "Ericsson." The magnet of the receiver is double poled, the core of Swedish steel, making it of unexcelled quality. The transmitters are designed on the "Ericsson" plan. They can be removed from the case at any time, having no flexible cord connections.

Constant additions are being made to their line of specialties and improvements, which have and will make these telephones the best known on the market. One new feature has been the design of an entirely new arm for telephone sets used in office service, the features of which will be illustrated and described in a later issue. Their desk set is an innovation, in having done away with the flexible cord attachment, which is at present one of the greatest features of movable outfits.

Messrs. Schmidt & Bruckner's new desk telephones are built with a hard-wood base, the bottom of which contains all the connections and the coil. The base is grooved out all around one inch from the outside edge, which allows an iron cover to set in over it. This iron cover acts as a weight and protection to the connections. It is removable at any moment. The bottom of the 'phone is not covered with cloth or plush, but disks are placed all around the outer edge, leaving the cover free to remove. From the wood base a handsome post extends, in which is a spiral spring surrounding a contact rod. This rod has a hook, shown in the illustration, for holding the receiver. This hook works up and down with the rod surrounded by the spiral spring, forming a switch contact in the base. This avoids the use of small springs, etc., such as are generally employed. They use a double-pole watch-case receiver with their desk set of the "Ericsson" type.

The magneto used with all their long-distance and exchange instruments is provided with binding posts for receiver, battery and reduction coils. This important feature allows of the detachment from the backboard without cutting either the battery or transmitter wires. The magneto is made exceptionally fine, the steel used being of the very best kind. The armature is made of the best soft laminated iron, assembled on steel shafts, and is accurately fitted. A chain and sprocket wheel are used for driving, the special hard steel chain being guaranteed not to scratch nor to wear. The standard generator rings through 10,000 ohms. The switch hook is of the long lever type, well made, with all the contacts platinized, thus insuring good connections. The illustrations will give the reader an idea of the appearance and general construction of the "Twentieth Century" high-grade telephones.

Particular attention is called to the intercommunicating wall set, with battery return call for common return, and to the intercommunicating metallic plug system, dispensing with the flexible cord. The interchangeability of all

their transmitters brings out quite an uncommon feature in their construction. The method of making contact with spiral-spring device, found in the desk set, is one of high merit. In fact, the newness in design and excellent finish of these telephones will recommend them at once to all purchasers. All instruments are sold under guarantee, the confidence of Messrs. Schmidt & Bruckner enabling them to stick to this guarantee on all occasions.

AN AMERICAN CIVIL ENGINEER IN KOREA.

Minister Allen sends the following, dated Seoul, July 16, 1898:

Korea has never had a proper survey made of its lands. The Treasury Department knows in a rough manner the extent of tilled fields as they existed a few hundred years ago, but new land brought under cultivation is apt to be known only to the country officials, who draw much of their considerable revenue from taxes on this new land. The people, of course, get no relief, for they will be most thoroughly taxed, whoever gets the money. Taxes are now paid in kind, and land is listed as rice land which is the best and most profitable, or upland, such as is used for barley, wheat, beans, etc. It has now been decided to have a complete survey made of the whole peninsula, preliminary to a just and proper assessment. An American, Mr. R. Krumm, of Columbus, Ohio, graduate of the Ohio University, has been engaged as chief engineer of the Korean Government "for the direction of all engineering work, such as the laying out of irrigation works, roads, bridges, fortifications, etc." Mr. Krumm has a five-years' contract with the Government at a compensation of \$300 per month for the first year, and increasing \$50 per month each year. He will also have house and certain expenses furnished. Mr. Krumm is now engaged with the engineering force of the Seoul-Chemulco Railway.

ELECTRICITY AS A FOG DISPELLER.*

The accident to La Bourgoigne, due to fog, has brought out a lot of suggestions for warning vessels when in close proximity to one another. Probably the most original suggestion that has yet been advanced is that of dispelling a fog by means of electrical discharges. Mr. Alexander McAdie, in a recent contribution to the "North American Review," advocates some such method, and gives his reasons for so doing. At the outset he states that air at sea level at a temperature of eighty degrees Fahrenheit, half filled with moisture, has eleven gram of water vapor to each kilogram of air. If the temperature is lowered, say fifteen degrees, through a change in the pressure, the air will become saturated with water vapor, or in other words, will have all it can hold. Mr. McAdie then goes on to say: "If the mixed air and vapor can be lifted about 4,000 feet, the rain engineer can ordinarily form a cloud or fog. Conversely, if he can increase the pressure and supply the requisite amount of heat, he can alter conditions so that no fog forms, or if it has formed, cause it to disappear. Provided we can control the thermo-dynamic conditions, we can condense the invisible vapor of the air into visible cloud, and on the other hand change the visible fog into invisible vapor." In Mr. McAdie's opinion this desired result might be accomplished by a method suggested by Professor Oliver Lodge, the well-known English savant, some time ago, in a lecture before the British Association at Montreal. At that meeting Professor Lodge related some experiments which he had carried on with a view to discovering a method of dissipating dust fog, which frequently gathers in towns and cities. He stated that he had found that a bell jar filled with magnesium smoke

* Boston Transcript.

or with steam could readily be cleared by an electrical discharge. Experiments were also carried on in a room filled with thick turpentine smoke, it being definitely shown that the air could be speedily cleansed of its solid particles by discharges of electricity at a high potential.

In 1887 Professor Lodge, while en route to this country, was detained for several hours by a very thick fog, regarding which he subsequently wrote as follows: "Fog is an unmitigated nuisance. Electric light is powerless to penetrate it, and as we lay there idle it was impossible not to be struck with the advisability of dissipating it. It is rash to predict what can be done. It is still rasher to predict what can not be done. I would merely point out that on board a steamer are donkey engines, and that these can drive a very powerful Holtz or Wimshurst machine, one pole of which may be led to points on the masts. When electricity is discharged into fog on a small scale the fog coagulates into globules and falls as rain. Perhaps it will on a large scale, too." Mr. McAdie thinks that the time has now come to try Professor Lodge's suggestion, made over ten years ago, and points out as one of his reasons that all steamships and even ferryboats, of any size are now equipped with dynamos which could readily be made to generate economically high potential currents of from forty to fifty thousand volts by the use of suitable transformers in series. He is of the opinion that "within a reasonable distance such discharges would certainly dissipate the fog and clarify the air." On the other hand, he admits that fog might be so dense as not to be affected by such electrical discharges, but thinks such cases would be exceptional. There would seem, in our opinion, no reason why such an experiment on a large scale should not be tried, as it could be done at comparatively little expense; whether it would prove successful, however, is debatable. That a discharge of high potential electric currents from a ship will dissipate heavy fog at any considerable distance from the vessel is scarcely to be expected, and unless the area cleared were of at least moderate size, thus allowing the lookout to see a considerable distance ahead and on either side, it would not render ocean travel materially safer than it is at present.

STREET-RAILWAY SPECIALS.



THE Sixth Avenue cars, operated by electric power, are giving great satisfaction to the Metropolitan Traction Company and the general public. This line extends from 59th street to 4th street. From 4th street the cars will run by way of West Broadway to South Ferry. About midnight last Friday the first trip was made. H. H. Vreeland, president of the Metropolitan Street Railway Company; W. Regan, of the Nassau Construction Company; W. Lang, superintendent of the National Construction Company; H. Belden, engineer of the latter company; General Manager Rounds, of the M. S. R'y Co.; Col. Harvey, of the Nassau Construction Company, and Walter Pierson, assistant to chief engineer F. S. Pierson, of the M. S. R'y Co., were aboard the first car. Walter Pierson, who formerly had charge of the lighting construction of the Brooklyn Heights Railroad Company, of Brooklyn, N. Y., ran the car as motorman. He took the handles of the controller and transmitted the current to the first electrically driven vehicle ever operated on that road. They started at an easy rate of speed, and the new road was tested and carefully inspected. Fourth street was reached at 12:30 A. M., and the car immediately returned. When business hours commenced the public took to the cars at once, and a rushing business commenced.

Mr. Sterges, the electrical foreman of the Flatbush Avenue line of the Brooklyn Heights Railroad Company, has been succeeded by the foreman of the Sumner Avenue line, who will assume his duties at Flatbush Depot. The career of Mr. Sterges as an electrician is excellent. In 1892 he was construction superintendent of the Consolidated Traction Company, of Albany, N. Y., and has held responsible positions in Boston, Philadelphia and Scranton. He was construction superintendent of a road erected in Trinidad, West Indies.

F. H. ROTH.

NEW YORK ITEMS.

MR. J. S. SPEER, the secretary of the Partridge Carbon Company, of Sandusky, O., spent a few days in New York, a short time ago, preparing the way for the introduction of their new "Perfection" carbon brush for motors. Mr. Speer is one of the most popular men among the electrical supply and manufacturing companies, his genial manner making him a favorite wherever he goes. Mr. James Partridge, the manager of the company, is a noted carbon expert and one of the most skilful manipulators of carbon in this country and Europe. The electric railway and other concerns using the "Partridge" brushes will appreciate the great improvements to be found in the "perfection" brush and the same will, without doubt, control the field as successfully as have the other brushes heretofore turned out by the above company. The Partridge Carbon Company also makes a specialty of carbon used for experimental purposes, all the great blocks of carbon used in experimenting with the manufacture of acetylene gas during the past few years having been manufactured by them. Their works are kept busy day and night in keeping up with the demand for their noted brushes, orders for 50,000 pieces for one road being considered nothing extraordinary.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 30 Cortlandt street, is preparing a new catalogue of its various lines of supplies and manufactures, and expects to have the same ready for distribution on or about October 10. Copies of this catalogue will be sent to all mentioning "The Electric Age."

WILBUR B. DRIVER & COMPANY, 126 Liberty street, sole agents for John A. Roebling's Sons Co.'s "CLIMAX" resistance wire, are now carrying a full stock of the same and are prepared to make prompt shipments from stock in all sizes from No. 5 to No. 36 B. & S. This wire has been growing steadily in favor since its introduction about a year ago and is now recognized as the standard wire for resistance work.

THE CHERRY ELECTRIC WORKS manufacture a perfect volt and ammeter at a surprisingly low figure. Circulars and price-lists will be sent on application, and they are well worth the time spent in looking them over.

THE NEW ERA METAL COMPANY, 26 Cortlandt street, manufacture a fine line of magneto and dynamo castings for the trade.

THE LE VALLEY VITÆ CARBON BRUSH is meeting with great success among users of the same on account of its self-lubricating, non-cutting and non-sparking qualities. The office of the company is at No. 39 Cortlandt street.

POSSIBLE INSTALLATIONS.

Florence, Ala.—The Florence Milling Company contemplates adding an electric-light plant to its mill.

Pratt City, Ala.—Pascal G. Shook and associates have received franchise for the establishment of a \$9,000 electric-light plant in this city.

Wynne, Ark.—William M. Kennedy, chairman board of improvement, may be addressed concerning bonds to be issued for the erection of an electric-light plant and the construction of a system of water-works.

Cassville, Mo.—Harrison Horine, mayor, may be addressed concerning erection of water-works and electric-light plant.

New Iberia, La.—A. J. Cammack, secretary, may be addressed concerning erection of an electric-light plant, construction of water-works in the near future.

New Orleans, La.—Cohn & Ber and T. M. Miller & Company have applied for franchises for the erection of electric-light plants.

Williamsport, Md.—Steps are being taken to erect an electric-light plant.

Oxford, N. C.—A movement is on foot to establish an electric-light plant in this city. Address Town Clerk.

Greensboro, N. C.—Steps are being taken to erect an electric-power plant for manufacturing and a more complete system of electric lights.

Orangeburg, S. C.—The mayor may be addressed concerning the erection of an electric-light plant and construction of water-works.

Chattanooga, Tenn.—The Heron Bedstead Company will erect a complete electric-light plant in its factory.

Houston, Texas.—Bonds to the amount of \$120,000 will be issued for the purpose of rebuilding the electric-light plant recently destroyed by an explosion.

Florence, Ala.—The Florence Milling Company will put in an electric-light plant in its mill.

Sherman, Texas.—An electric-light plant is being established in this city.

TELEPHONE CALLS.

Trenton, N. J.—The Atlantic County Telephone Company has been incorporated in Atlantic County, N. J., by Frederick L. Benson, Alfred Dingler, Jersey City; John J. McCloskey, Philadelphia; to operate in Atlantic County. Capital stock, \$100,000.

Ottumwa, Iowa.—The Ottumwa Long-Distance Telephone Company has been incorporated by J. C. Goddard, A. H. Cowdery and P. E. Wilcox, to build a long distance telephone line in the States of Iowa and Missouri. Capital stock, \$10,000.

Meridian, Miss.—The Meridian Telephone Company has been incorporated by J. D. P. Lewis, J. P. Walker, Henry A. Coit, Henry A. Turner and others with a capital stock of \$16,000.

Atlanta, Mo.—The Atlanta Telephone Company has been incorporated by H. H. Abbott, S. H. Nash, R. B. Turner and others. Capital stock, \$2,700.

Bolivar, Mo.—Franchise has been granted to J. C. Pike and H. S. Bruce for the construction and operation of a telephone exchange.

Morgantown, W. Va.—The Morgantown & Dellslow Telephone Company has been incorporated with a capital stock of \$100,000. Capital subscribed, \$500; amount paid in, \$50.

Ronceverte, W. Va.—The Greenbrier & Pocahontas Telephone Company has been incorporated with a capital stock of \$1,500.

NEW INCORPORATIONS.

Des Moines, Iowa.—The Postal Telegraph Cable Company has been incorporated by C. F. Fox, R. J. Wurst, and R. W. Banks; for the construction, acquisition and operation of telegraph lines within the State. Capital, \$50,000.

Detroit, Mich.—The American Electro Neurotone Company has been incorporated by Fred W. Christie, Niagara Falls, N. Y.; Daniel B. Stevens, Toronto, Ont.; Rollin H. and Clara B. Stearns, Pine Bluff, Ark.; R. L. Gibson, Toronto, and L. G. Christie, Toronto. Capital stock, \$30,000.

TREET-RAILWAY NEWS.

New York, N. Y.—The Safety Third Rail Electric Company has been incorporated by Emerson McMillan, Jr., W. F. Douthirt, C. T. Schoville, R. H. Beach, William M. Keepers, David F. Halsted and others. Capital stock, \$1,000,000.

BUSINESS CHANGES.

The American Electrical & Maintenance Company, No. 451 Greenwich street, went into the hands of receivers October 4, Justice Smyth, of the Supreme Court, having appointed Aldred K. Warren and Francis Higgins in proceedings brought by the directors for the voluntary dissolution of the corporation on the ground of insolvency. The liabilities are \$35,199, nominal assets \$29,126, actual assets \$17,398, consisting of books, accounts, tools, patterns and materials in process of manufacture. The order to show cause for the dissolution was set down for January 16, before Hamilton Odell, referee.—N. Y. Journal.

INVENTORS...

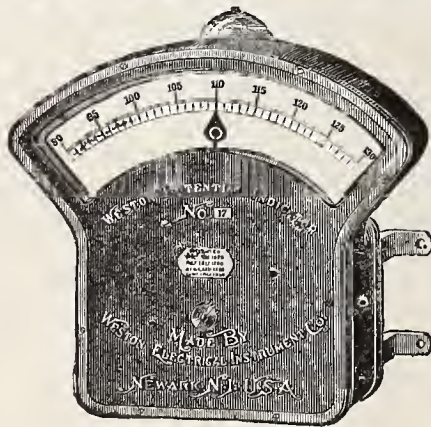
WHAT IS WRONG

With your invention? Why can't you get capital? We will tell you. You require endorsement by competent experts; we have them. If your invention has merit, our endorsement will enable you to get capital. Try us. Fees moderate. Correspondence solicited.

Address **ELECTRICAL AGE,**

Room 14, World Building, N. Y.

WESTON STANDARD ILLUMINATED DIAL STATION INSTRUMENTS.



THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

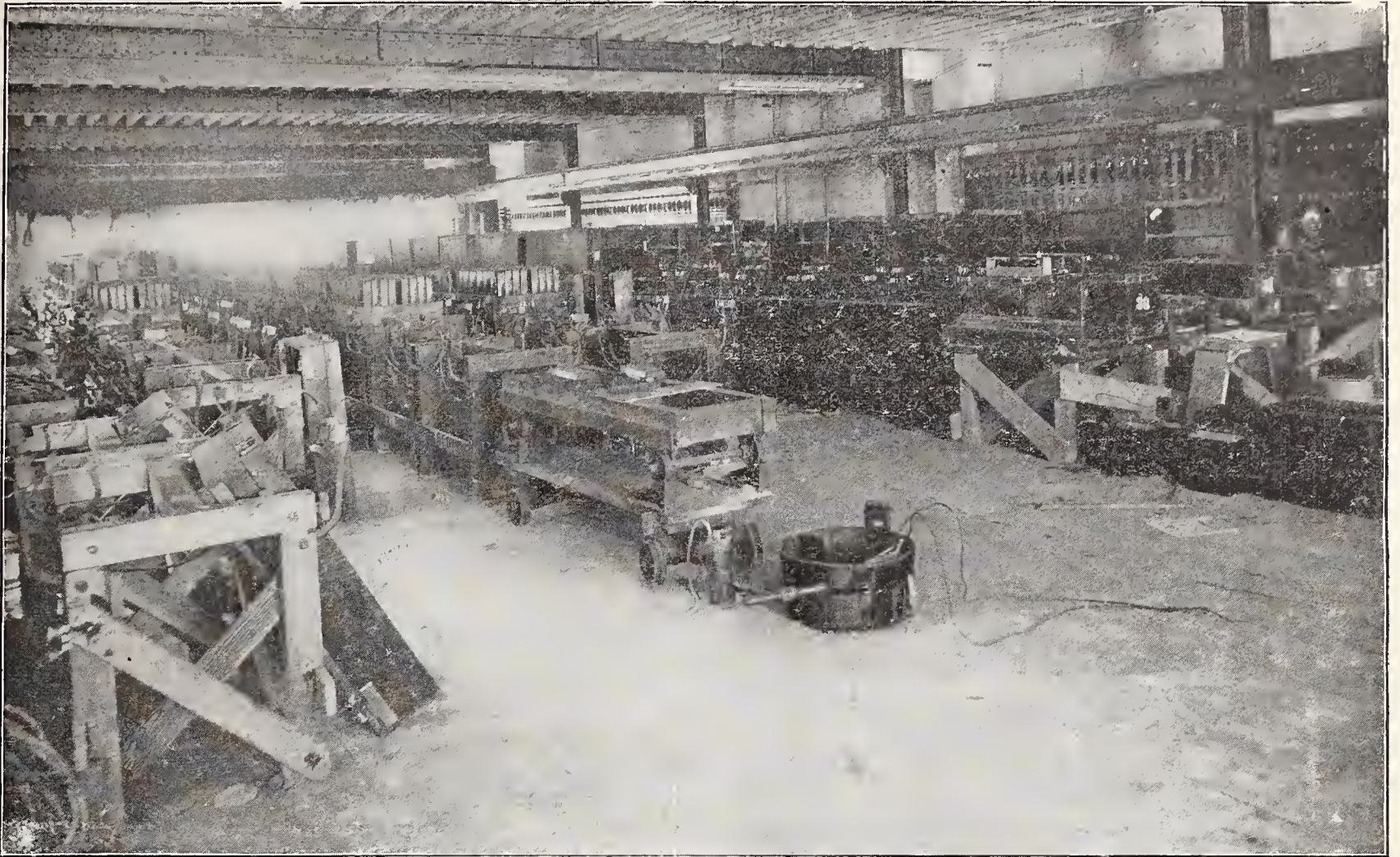
The Electrical Age.

VOL. XXII—No. 15

NEW YORK, OCTOBER 8, 1898

WHOLE No. 595

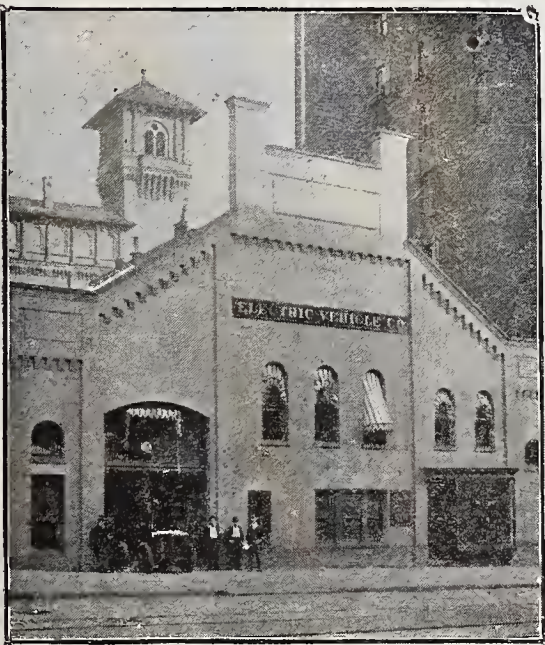
ELECTRIC AUTO-MOBILES.



Interior of Battery Room in Station.

CENTRAL STATION OF THE ELECTRIC VEHICLE COMPANY.

(Through the courtesy of the "Horseless Age.")



Exterior View of Station of Electric Vehicle Company.

The most complete plant in the world for the care and maintenance of electric vehicles is just being completed by the Electric Vehicle Company at No. 1684 Broadway, New York. The chief feature of this plant is the remarkable facilities for charging, loading and unloading the storage batteries from the cabs.

The old cabs, of which 12 were in service for

The building chosen for the station is an old rink fronting on Broadway and running through to Seventh avenue. Its dimensions are 75 × 200 feet, and as a storage place for cabs a floor has been raised over about half of the interior above the battery room, while in the front are business offices and in the rear drivers' rooms and a machine shop.

The battery room is 37 × 100 feet, and here several hundred batteries may be kept either charging or charged ready for use. At each end of the battery room are two elevators for raising and lowering cabs to the store room above.

In front of this room is the battery-loading machinery. Both the loading and unloading are accomplished almost entirely automatically. The carriage backs up against the charging table, its battery is removed and replaced, and the discharged cells are carried back into the battery room and deposited upon the proper racks and automatically connected with the charging circuits. If the vehicle requires attention or is not to be used for a time it simply recharges its battery and is hauled to the space alongside of the battery room, where it is washed and cleaned and sent back to its resting place on the upper floor by the rear elevator till again wanted. If it is simply recharging, it, of course, receives a new battery. The time required for this operation is about three minutes.

The weight of the new cab, including the battery, is about 2,900 pounds. Its length from end to end is nine feet; at its widest portion the body measures five feet;

over a year, have been displaced by cabs of new and improved design, though following the earlier model in the salient mechanical details. Fourteen of the new vehicles are now in service, and 20 or 30 more will be added soon. Of the 50 broughams ordered only one has been put in service, as the season for this class of vehicles is yet distant.

the wheel base is 4 feet $7\frac{1}{4}$ inches, and the gauge of of both front and rear wheels is 4 feet 10 inches. In regard to the arrangement of the driving and steering gear the same disposition has been adopted, the wheels being used for driving and the wheels under the battery box for steering.

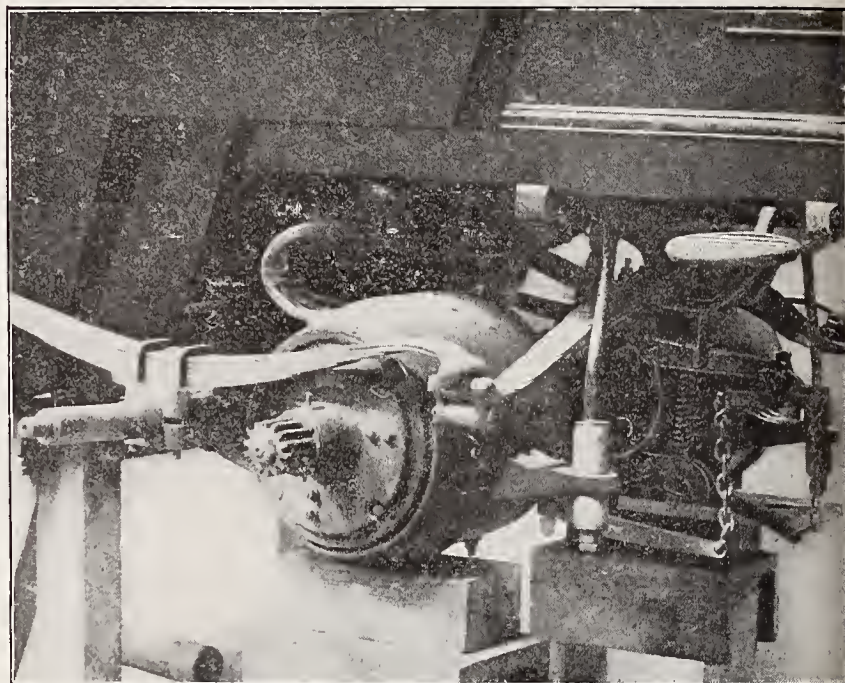
One of the most striking changes is the massive pneumatic tires. Experience demonstrated the failure of the 3-inch pneumatic tire with which the old cabs were equipped, and a 5-inch tire was adopted. They are made

their periphery to the convex edges of the metal rim and expand to the hub, to which they are bolted. The diameter of the wheels is 36 inches, and the weight approximately 100 pounds each. Several of the cabs have been equipped with a wooden-spoked wheel with better results.

All four wheels have roller bearings, with double ball thrusts. The width of the running bearing surface is about 5 9-16 inches. The driving wheels revolve about a fixed axle measuring $1\frac{1}{2}$ inches at the bearing ends and centrally fastened at either end to a flat compound spring,



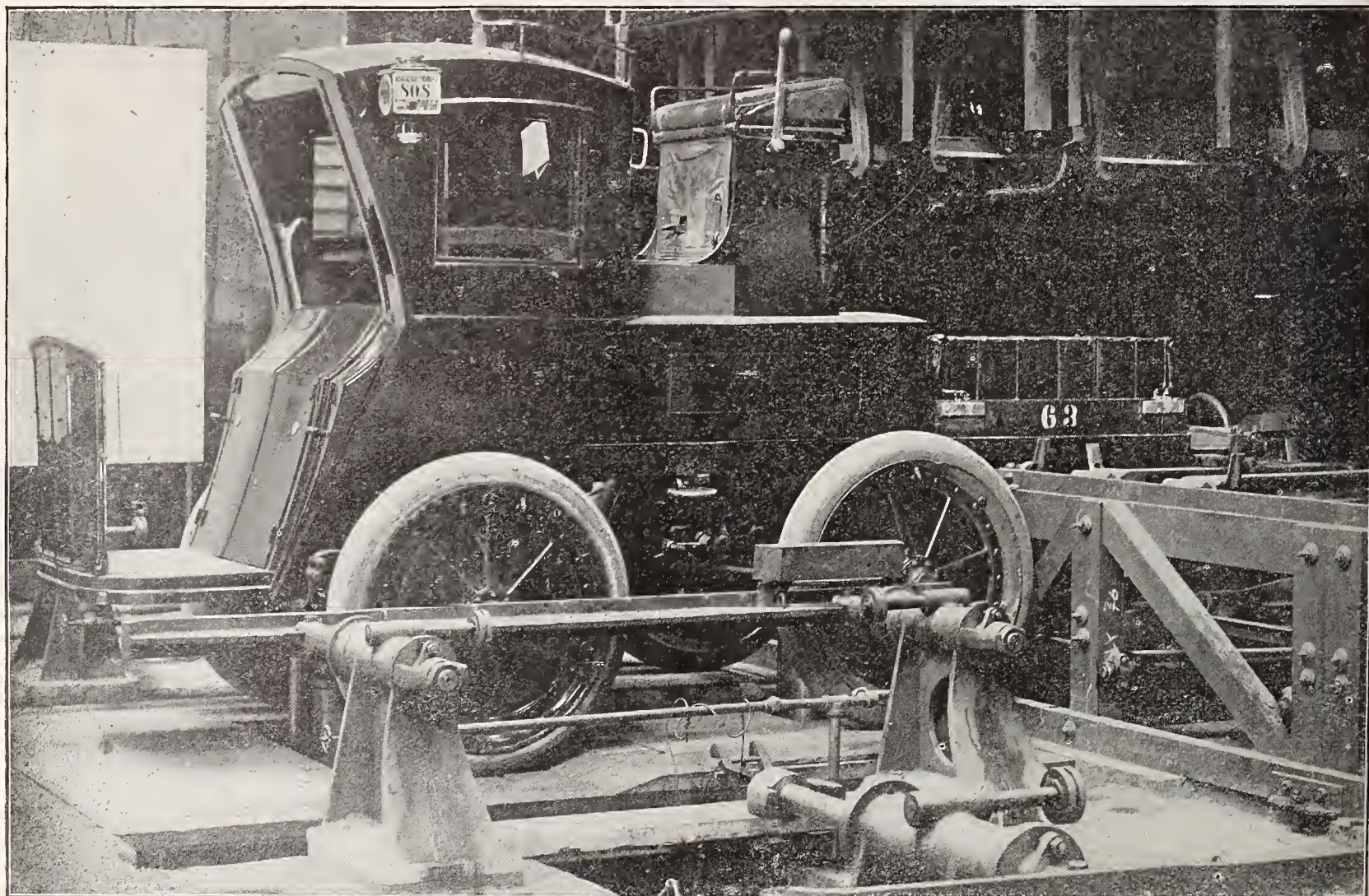
Electric Vehicle Company's New Car.



Motor Suspension and Brake Mechanism.

of $\frac{1}{2}$ -inch rubber hose stock. Larger wheels would have been used had it been possible to obtain the necessary tires. The present 5-inch tires are pumped to the pres-

ure of $\frac{1}{2}$ -inch rubber hose stock. Larger wheels would have been used had it been possible to obtain the necessary tires. The present 5-inch tires are pumped to the pres-



Electric Hansom, Showing Hydraulic Ram for Side Alignment and Battery in Position for Loading.

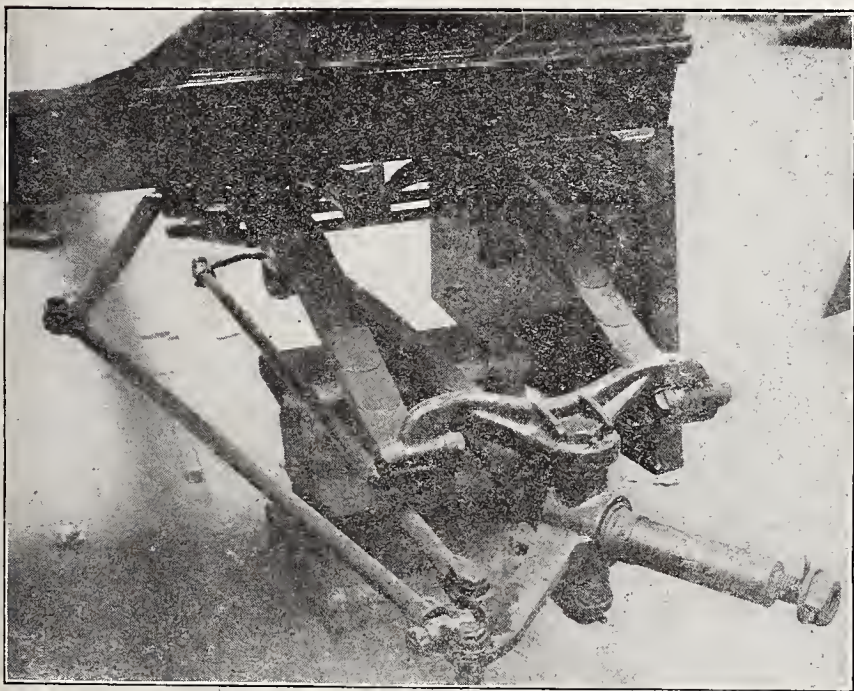
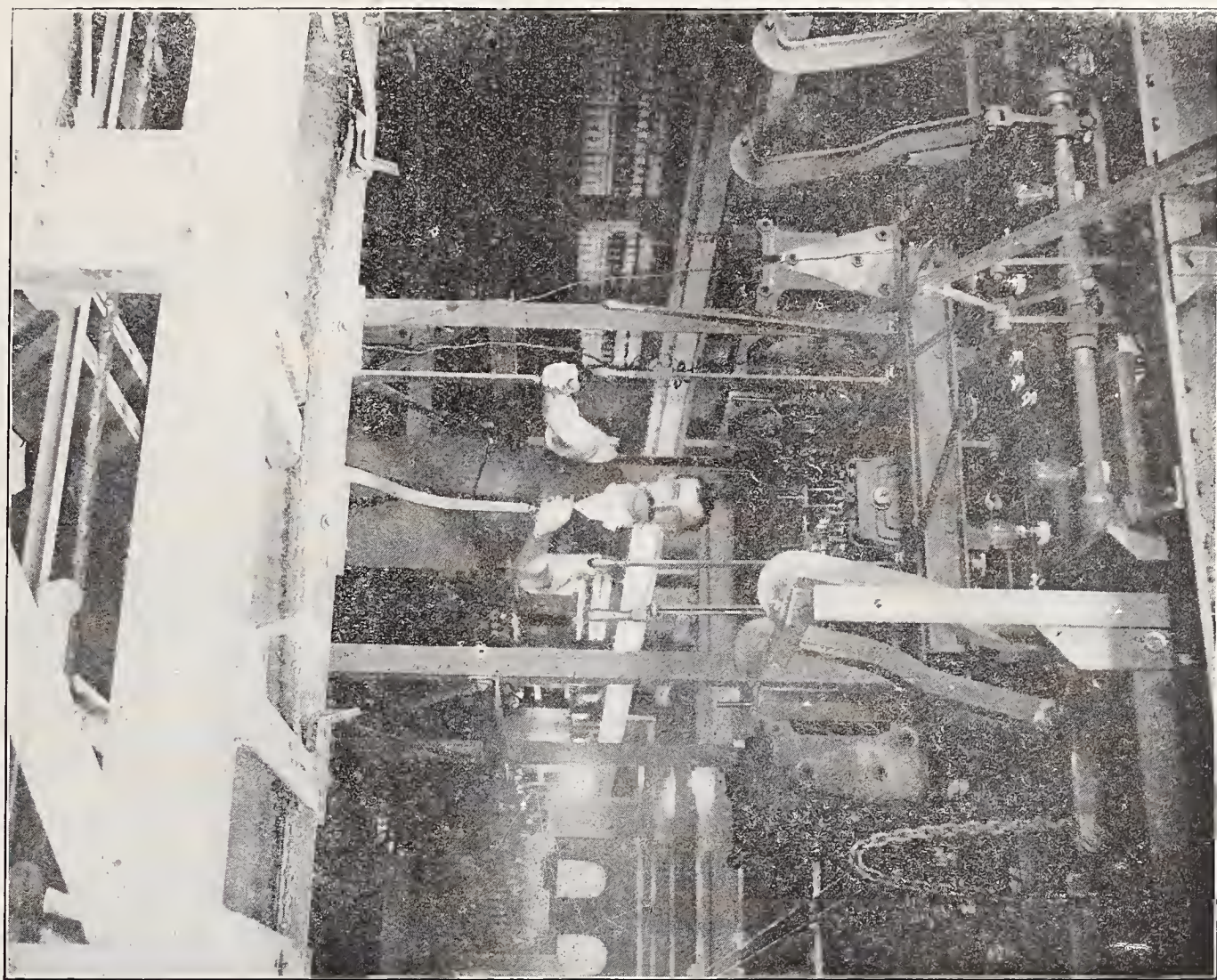
sure of 60 pounds. The vehicle wheels are built of two stamped plates of $\frac{1}{8}$ -inch steel. They are fastened at

The series-wound motors are of a new water-proof iron-clad construction, and resemble the general type of street

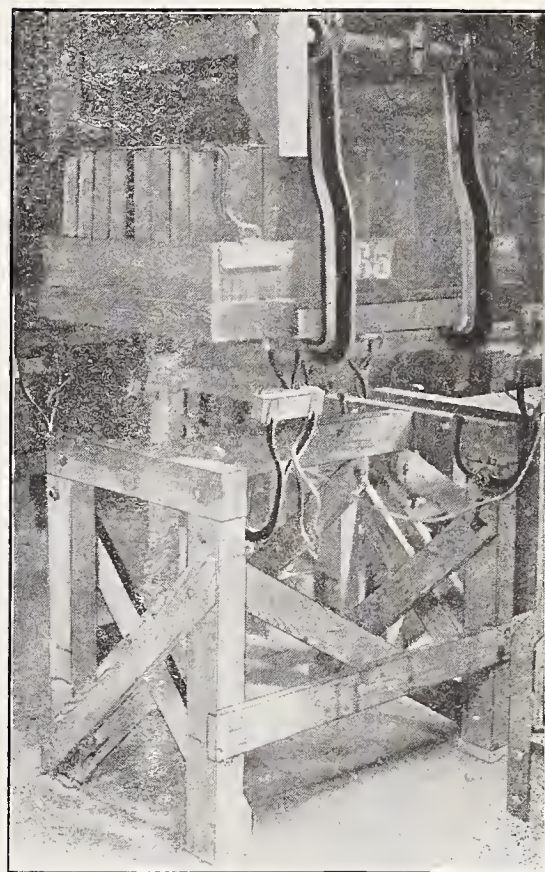
railway motor. They were built by the Westinghouse Electric & Manufacturing Co., and have a capacity of 2 H. P. at 700 r. p. m., when working at 80 volts, the potential of the battery in each vehicle. With the exception of a small hinged door at the commutator end of the

the inside of each driving wheel. Thus fitted to the wheel the gears almost directly transmit their strain to the rim, instead of passing it through the web or hub. At the opposite side of the motor a projecting arm is held between two rubber springs. This motor gearing pos-

View of Crane Cab and Operator.



Steering Gear.



Charging Table and Grappling Devices.

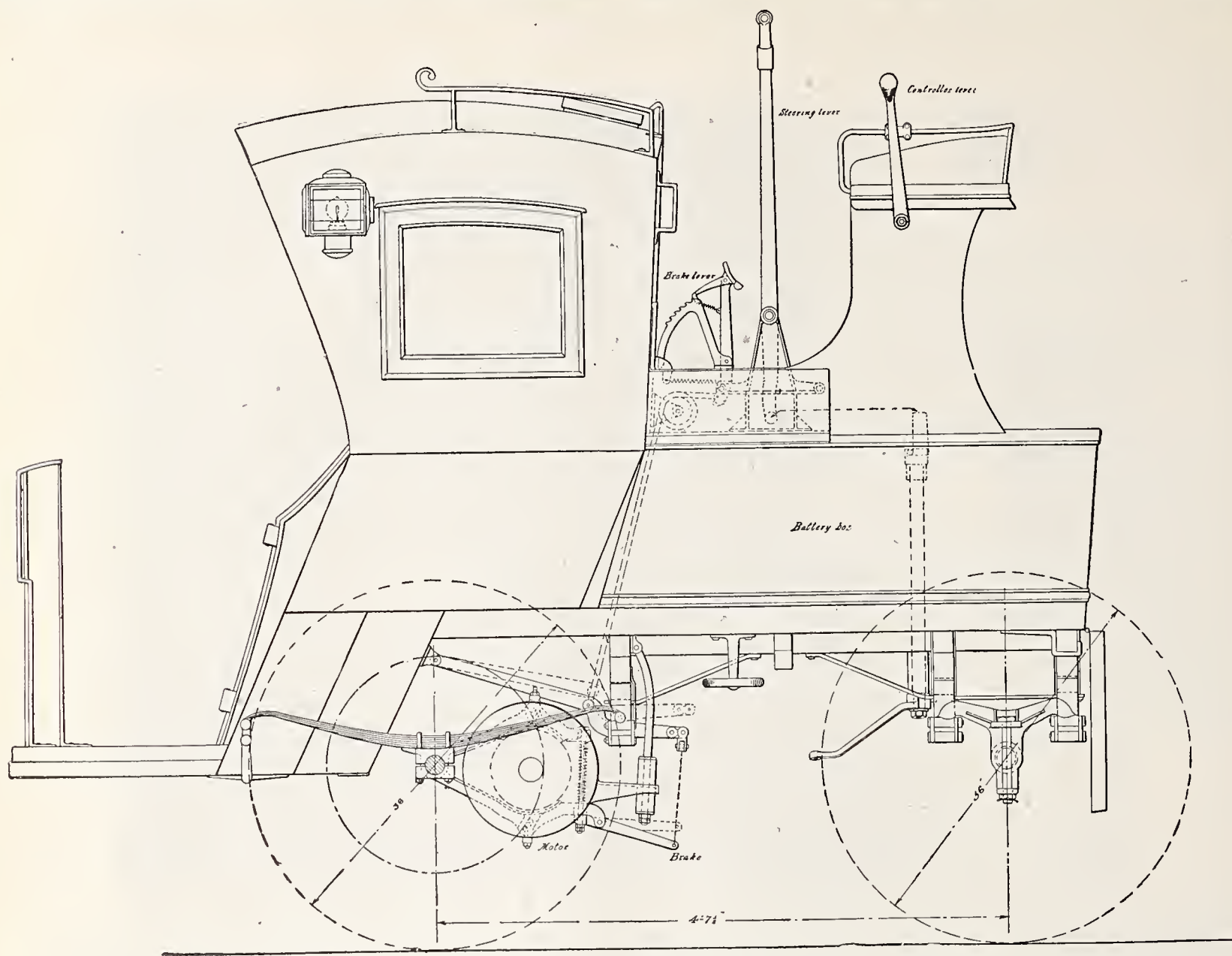
outer casing, the motors are practically sealed. In supporting these motors and gearing them to the drivers, electric railway practice has been followed. Each motor is pivoted by a projection to the fixed axle, adjacent to its respective driver. A small spur gear pinion meshes into an internal gear, 21 inches in diameter, attached to

sesses all the elements of the flexible pivotal suspension. The steering gear is of the pivoted type.

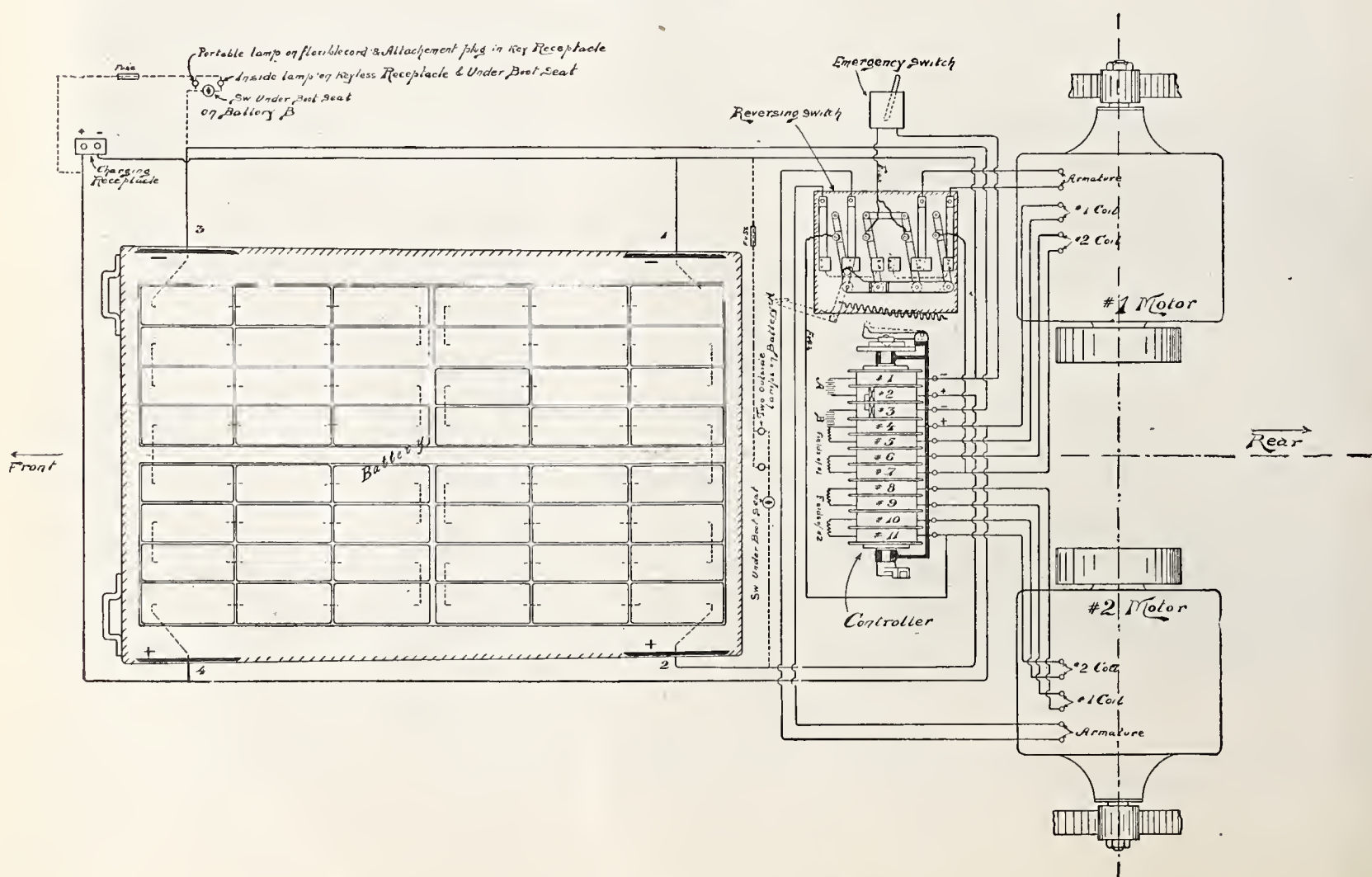
It will be noted from the illustrations that each set of wheels is independent. The driving and steering wheels are separately attached to the vehicle body, through the medium of the spring supports.

Each cab is equipped with 48 cells of battery, which contain two Manchester positive and three chloride nega-

tive poles. The battery has a rated output of 100 am-pere hours at the normal discharge rate, but the irregular



Side Elevation of Electric Cab.



Controller and Battery Connections.

The Electrical Age.

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THE INCREASING USE OF ALUMINUM FOR ELECTRICAL CONDUCTORS.

Aluminum, or, as it is technically called, aluminium, is a metal whose future history in applied electrical engineering is slowly becoming one of great consequence. The electrical conductivity of aluminum is so great comparatively that there is every reason to suppose a change of sentiment regarding its use. It possesses qualities of strength, lightness and conductivity which should insure its receiving a favorable reception at the hands of broad-minded experts. Mr. Alfred E. Hunt, whose name in connection with the aluminum industry is well known, claims a conductivity for aluminum of more than one-half of that of copper. Bulk for bulk, aluminum weighs less than one-third that of copper.

It is evident from these facts that an aluminum conductor capable of carrying a given current would have about twice the cross-section of a copper conductor and about two-thirds the weight, or less. The cost of a power transmission line involves not only the expense for copper, pure and simple, but the expense as well for its erection. The heavier the conductor the stronger must be its supports and the more massive the insulators attached to it. Gisbert Kapp's modification of Sir William Thomson's law, as well as Prof. George Forbes' opinion in relation to conductors used for transmission of power, might be applied in this case, particularly the latter. It seems as though the cost of laying each additional ton of copper has largely to do with the cross-section of the conductor. Can the cost of laying an additional ton of copper or any other metal be reduced? In other words, does the use of aluminum as an electrical conductor mean a saving in dollars and cents?

Mr. Hunt states as follows: "To obtain a conductor of aluminum at the same cost of metal per mile, the cost per pound of the aluminum may be two and one-tenth times greater than that of copper. Assuming the cost of the copper at fourteen cents per pound, it is evident that aluminum at twenty-nine cents per pound is slightly cheaper than copper. The strength of an aluminum wire can be made as great as that of a copper wire, more than thirty thousand pounds per square inch; the aluminum wire, however, possessing a greater cross-section than the copper wire, in order to have an equal conductivity, will be a stronger wire. Consequently, we find the following features in favor of aluminum: The cost less than copper, the strength greater than copper, and the weight less than copper. Several large power transmission plants are now using aluminum conductors. It is very likely that its use for this purpose will soon become better known and the demand more general.

ELECTRICITY IN MODERN SURGERY.

The use of electricity in modern surgery has kept in line sufficiently to stamp its progress as indicative on the part of the medical fraternity of a full appreciation of benefits derived from its use. The field of electro-cautery is too well known to dilate upon, yet the modern surgeon, the up-to-date specialist, finds electricity a most beneficial agent in his general practice. The dental world has become thoroughly familiar with the principles of cataphoresis, which implies the transmission of a medication from one point to which it is applied externally to another. The use of electric saws for surgical work, such as amputation, etc., has been of great service to the profession, and in electro-therapeutic work the use of currents as tonics, stimulants and invigorators of the nervous system has become a fixed part of medical practice.

Dr. C. R. Dickson, president of the American Electro-Therapeutic Association, at the recent meeting of the organization in Buffalo, made the following remarks: "The old-time practitioner, then the physician and surgeon, seems passing away. Surgery is divided and subdivided until at one time we feared that we were to be confronted with an appendix surgeon. The time is past when a physician, the proud possessor of a solitary magneto-electrical machine, turned by a crank, considered his "armamentarium electricum" quite complete. One has but to glance at our programmes to see to what extent electricity may be used and used to advantage. . . . Electricity is an agent most powerful for weal or woe. A great responsibility rests upon our educators, and the sooner they awake from their strange lethargy the better will it be for our reputation as an enlightened, progressive and scientific profession. The commercial world has taken such advantage of the rapid strides of electricity as a science with fixed laws that we have laid ourselves open to the charge of neglect."

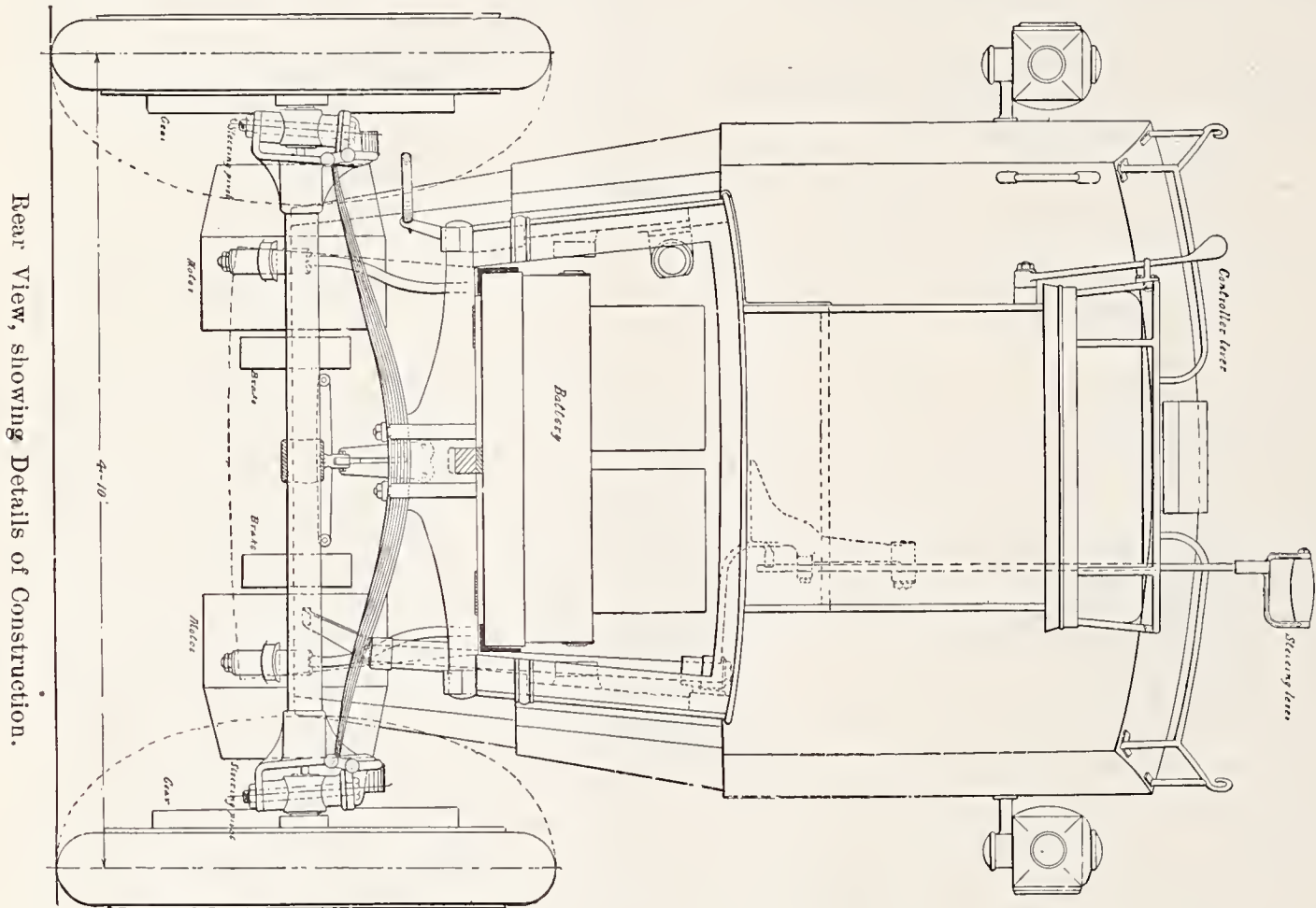
Perhaps Dr. Dickson does not fully realize that the cautery needle and X rays have practically transformed certain departments of surgery. His idea that the medical world is not progressing rapidly is a mistaken one. It has used electricity on every occasion dictated by judgment and experience. Large concerns manufacture apparatus of an electrical character exclusively for physicians. Electricity in modern surgery has left the field of charlatanism. The expression is not ambiguous. As a remedial agent it is applied by some of the best physicians in this country. There are certain misapplications of it made, but these are striking exceptions, and on the whole criticisms of its use have been, abroad as well as in the United States, of a most favorable nature.

Chicago, Ill.—Eureka Electric Co. has been incorporated, with a capital stock of \$10,000.

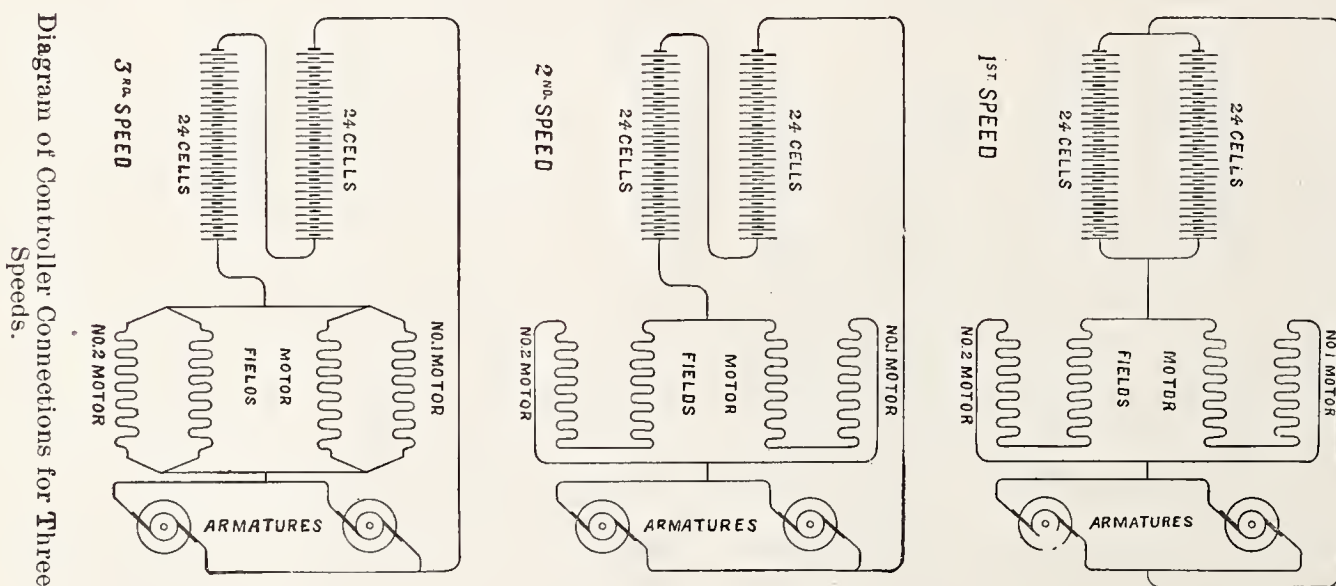
demands of this service change the rating. Each cell weighs 26 pounds, making the total weight of the battery caried by each vehicle 1248 pounds, exclusive of the holding tray.

The entire battery equipment for each vehicle is in a single box, thus making it possible to handle it as a unit. The tray, which is of wood, is slightly tapered, so as to fit the vehicle box snugly and insure good contact. The battery in its tray measures 26 inches in width by 3 feet 3 inches in length and 16 inches in height. The connec-

troller is at "off." The reversing switch is normally set for the ahead position and so remains, unless pressure is kept upon the operating lever. Three speeds in either direction are provided, namely, 6, 9, and 12 to 15 miles an hour. The various combinations of the battery and motors are shown in the controller diagram. The battery is divided into two electrical sections, and the series fields are also in sections. Various series and parallel arrangements of the field coils and battery produce the three speeds. With a single charge the vehicle can be operated



Rear View, showing Details of Construction.



tions between the cells are burned together and those between the battery and controller system are automatically made, when the former is placed in position. The automatic contacts engage with four contact strips on the side of the battery box. The bottom of the battery box is lead lined and provided with suitable drainage channels.

The operation of the vehicle requires three appliances, all located at the side or in front of the driver's seat. The speed of the motors is controlled by a switch cylinder, placed transversely under the driver's seat and operated by a rotary motion imparted by an upwardly projecting handle. This cylinder is used in combination with the reversing switch, which is provided with levers operated by the driver's foot. The arrangement is interlocking, and therefore it is impossible to reverse unless the con-

about 25 miles.

An emergency switch is provided, which has a removable key handle and is placed in an easily accessible position near the driver's foot, so that when occasion demands he can move the handle and thus cut off all current. This switch is also used when the driver leaves the vehicle. By removing the handle the switch is opened and cannot be closed until the handle is replaced, thus preventing any tampering by unauthorized persons.

The brake is operated by means of a foot lever and acts upon the armature shaft. It is of the double-acting shoe type and is applied to the brake pulley. The brake shoes are in the form of curved levers, one end of which pivots on the axle.

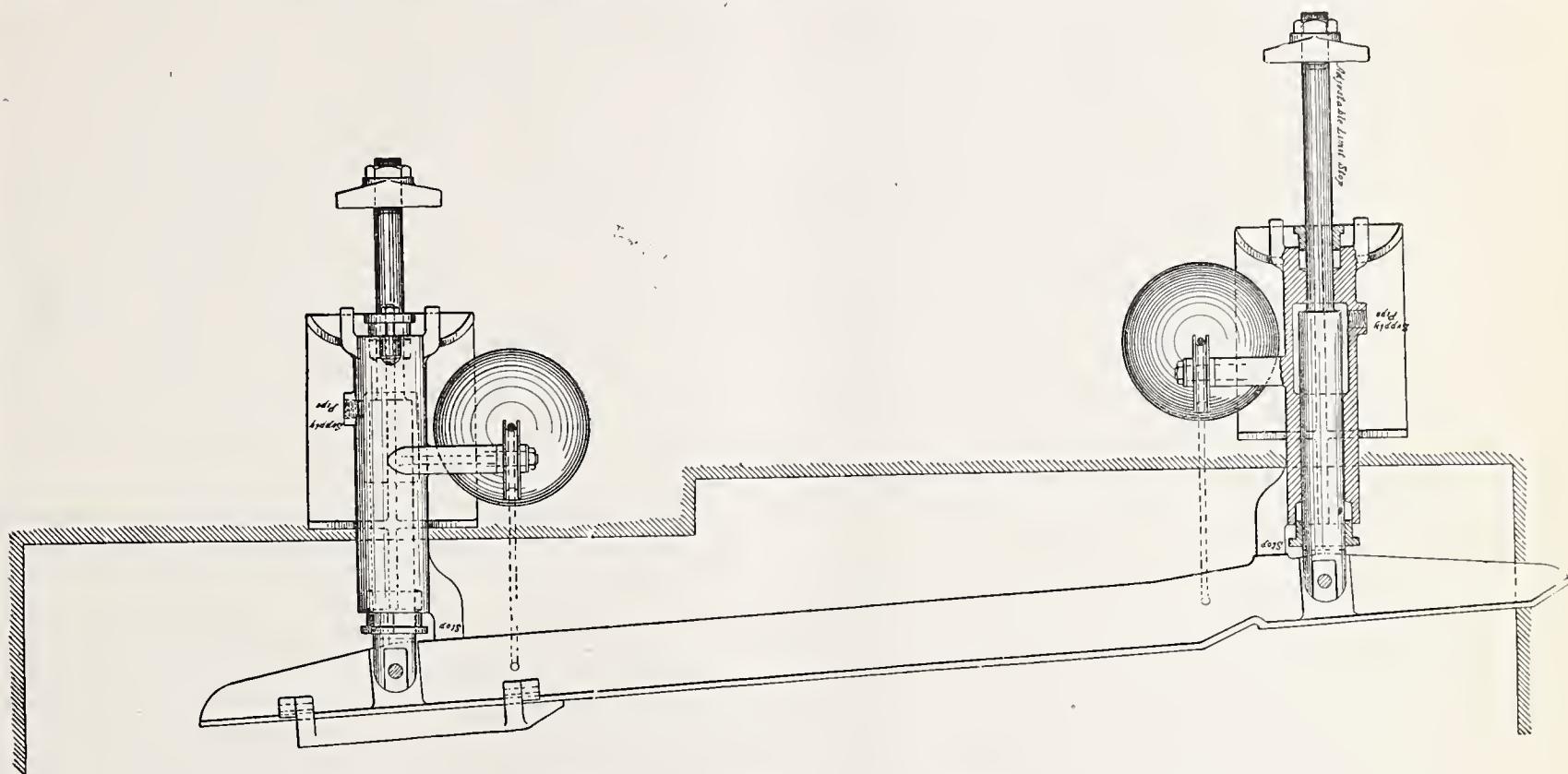
The operator has one foot always on the brake lever and

the other ready to operate either the reversing or emergency switch or the bell-ringing lever. His hands are occupied with the steering lever and the controlling handle.

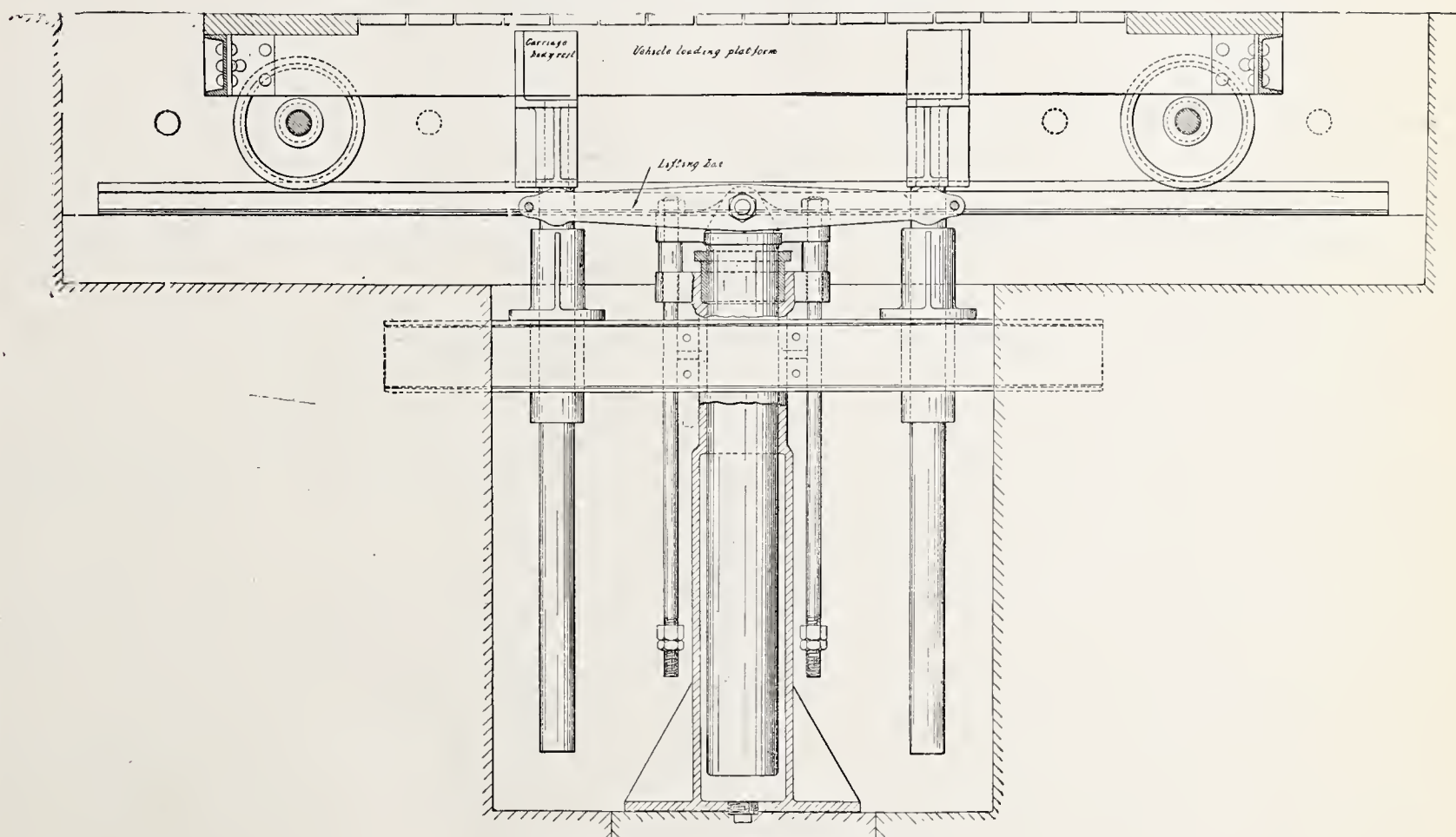
An important feature in the construction of the vehicle is the duplicate character of the various parts, including controller, motors, switches and other parts likely to fail. The speed controller contact fingers are

capacity in the near future, and several of the omnibus type are being considered.

The battery equipment for the present service consists of 150 trays, each containing 48 cells. This allows $1\frac{1}{2}$ trays per cab, which leaves ample reserve, even though nearly all the cabs should be in service. The disposition of the batteries when not in actual service on the vehicles or when charging is excellent.



Hydraulic Ram for Side Alignment.



Hydraulic Ram Underneath Platform.

duplexed, so that each terminal from the battery or motor is connected to two stationary contact fingers. Each complete set is arranged in a separate row, engaging with the contacts on the cylinder. The contact plates on the battery tray are also in duplicate. The battery may be charged without removing it from the vehicle by connecting with the charging plug receptacle, fitted in one of the corners of the battery compartment. This receptacle is conveniently arranged and coacts with a suitable plug attached to the charging mains. It is expected to add vehicles of larger

Owing to the large floor space available, all of the battery holding racks have been placed on one level. The battery room is floored with cement, as is also the entire ground space outside. Each tray of battery cells has a separate rack, built of 3x4-inch yellow pine, mortised at the joints, held together by wooden dowels, and coated with water-proof paint. The height from the floor to the top, on which the battery tray is placed is 33 inches.

The arrangement of racks is shown in the general floor plan of the station. They range longitudinally

from end to end of the battery room, with a narrow passage between each row. The central passage is wider than the others to accommodate the crane cab. There are also three wider passageways transversely across the battery room, in addition to those at the ends. Thus, the eight rows are cut into four parts, each containing six racks, which are tied together by wooden planks and rigidly fastened to the floor. This divides them into eight sections, each accommodating 48 trays, with the exception of the end section nearest the loading machinery, which has eight additional racks, making an aggregate of 200. These sections are provided with suitable drainage channels, and a large wire channel runs transversely from the charging switchboard on the inner wall of the building along each of the passageways. The lowering of the battery into the rack automatically connects it with the charging wire. At each corner of the rack is a curved lever, pivoted on the side of the upper timbers. The upwardly projecting ends are fitted with insulated spring contact straps, and when the lever is moved these describe an arc, thus bringing them in contact with the connecting plates on the ends of the battery tray. The weight of this end of the curved lever causes it to swing free when the cells are raised. The other end of the lever is quite short and projects an inch or two above the top of the tray supporting timbers. When the battery is lowered its weight strikes upon these projecting ends, causing the other ends to spring up and make secure contact with the plates on each side of the tray. As the cells in each tray are divided into two sections, it is necessary to provide each rack with four of these automatic contacts. The charging wires are connected to two diagonally opposite contacts, and the other two are cross-connected by a flexible rubber-insulated cable. This connects the entire 48 cells in series across the line.

Instead of furnishing the charging current from an isolated generation plant in the building, it has been found preferable for the present to take the supply from the Edison service.

At the Broadway end of the building two three-wire 350,000 c. m. service connections are brought into the north wall, whence they connect through three-pole switches to cables of 1,500,000 c. m. capacity leading to the main switchboard, which is located between the battery room and the offices. This main board is made up of nine white marble panels, each 3 feet long, making the entire length of the board aggregate 27 feet, with a height, including the supports, of 8 feet. At this board the three-wire street service connects, through the medium of the appliances on the panels, to a series of buses of raised or lowered potentials. These buses, of various voltages, are carried to the battery charging panel further on in the battery room. The connections of the main board, as well as the charging board in the battery room, are shown in the diagram.

The neutral wire of the service simply passes through a single-pole switch on the first panel to the left, and from thence directly to the charging racks, where it connects at each rack with one of the previously mentioned automatic contacts. The first four panels to the right of the main board control charging buses connected to the positive side of the service, while the succeeding four control negatively connected buses. The battery racks are connected to both the positive and negative charging buses through the switches on the charging board. The buses are thus connected at their respective panels through a single pole switch, and under-load or over-load I. T. E. circuit breaker and a large rheostat, whereby the potential may be lowered to any desired extent. This arrangement is the same with all of the charging panels, except the first and fifth, which are arranged to boost the potential of the connecting charging buses, or keep them at the same point as the street service. In this case the

rheostat is omitted, and a double-throw pole switch is installed, which throws the buses in series with a boosting dynamo, or simply connects directly to the service buses. The capacity of the instruments on each of the charging panels and their respective buses ranges in steps of 100, from 100 amperes for the high-pressure panel to 400 for the low. The last panel on the right is to be used for light and power switches and instruments.

The booster equipment consists of a $7\frac{1}{2}$ -H. P., 220-volt multipolar dynamo, centrally placed between two bipolar booster dynamos. The armatures are directly coupled together. One booster raises the potential on the positive bus, and the other is used on the negative side, and the capacity of each measures 200 amperes, at from 5 to 15 volts. These machines are placed on a heavy wooden platform above the switchboard.

The object of the various charging buses will be apparent on examination of the charging panels. These are arranged in two groups in the battery room. They are built of heavy slate slabs, measuring 30 inches x 60 inches. Each panel is equipped with the instruments for eight charging circuits leading to the racks. A separate wire from each battery rack extends in a lead-armored cable, laid in the previously mentioned trenches, to its respective panel section. Each battery wire connects through a form of solenoid ammeter to a four-point switch arm, whereby it can be connected to any one of four charging buses. The upper row of ammeters and switches is connected to the positive buses and the lower row to the negative. In charging, a battery is connected, first with the lowest bus through the four-point switch and gradually worked up until the highest bus is reached.

To govern the changing from one bus to another, according to the current fed to the battery, the ammeters are provided with a tell-tale lamp indicator, which is set at charging current, 20 amperes low and 50 amperes high. Should the current fed to any battery reach these extremes a red or green incandescent lamp is lighted. Only one set of lamps is provided for each panel, and the lighting of the low-range lamp shows that one of the batteries on that panel has fallen below the 20-ampere point and must be connected to the next bus. The only attention necessary is the shifting of the charging switches from time to time, and this is done by the man who operates the crane and loads and unloads the vehicles. In fact, he can control the entire equipment, almost without leaving his station on the crane cab.

To withdraw the fumes from the somewhat inclosed space which comprises the battery room, a 40-inch exhaust fan is placed on the upper floor and operated by a belted electric motor. The fan suction flue originates about the centre of the partition wall, while the outlet is brought to the roof.

On the outside of the partition wall at the forward end of the battery room charging receptacles are placed, so that any vehicle may be connected with the charging wires without unloading its battery. Batteries so connected are manipulated in the same manner as if they were on their racks in the battery room.

The most important element in this installation is the battery-handling machinery. The various parts form practically one machine, which is manipulated by a minimum of manual labor. The work involved in handling a vehicle includes the carrying of the battery from the rack to the loading point, and here, after proper alignment, pushing the battery into its compartment. In unloading, these operations are reversed. The battery is moved from the rack to the loading point by means of an electric crane, carrying eight electric-battery hoists. This crane has a capacity of eight tons and runs the entire length of the battery room, which it spans from side to side. On each side of the operating cab, which is centrally suspended from the bridge and almost touches the floor, are the battery hoists. These are placed side by side, four on each side of the cab, and come directly

over each row of battery racks. Each hoist has a capacity of one ton and works in conjunction with a lifting and lowering grapple, which automatically engages with the battery tray. The grappling arrangement consists of two heavy iron jaws raised or lowered by two chains, one of which performs the hoisting and the other manipulates the grappling arms. The drums for each of these hoists are operated by a separate worm-gear motor. In raising a battery from the racks the grapple is lowered in its open condition until it reaches the limit of the chain, which is set so that the arms are then just below the bottom of the tray. The further rotation of the hoisting drum winds the chain up again, closes the grappling arms around the bottom of the tray and raises it to the desired height. The operator in the cab simply starts and stops the motor, which starts in one direction only and does the rest. The battery is now carried to the loading transfer table, which is also electrically operated. This mechanism is really a link belt conveying machine, and extends across the entire front or loading end of the battery room. It consists of heavy iron crossbars with upward projections, forming the sections into which the tray fits. The battery is lowered and deposited in one of these carrying sections of the conveyor. The lowering and releasing is the reverse operation of the raising and is accomplished by an opposite rotation of the hoisting drum. The transfer of the battery tray from the conveyor or table to the vehicle compartment is accomplished by hydraulic machinery. In front of the table are two vehicle loading and unloading platforms. Each of these platforms is composed of two wooden flat carlike structures placed side by side, so that their platform is on a level with the flooring of the station. The wheels upon which these platforms are placed run on parallel tracks in the platform pits, the motion being in line with the conveyor table. Each half of the loading platform has four wheels and the two parts are automatically aligned with each other and centred by means of suitable weights. The vehicle backs on to the platform, so that each pair of wheels has a movable car to itself; and the vehicle can then be shifted from side to side and suitably aligned with the conveyor rack. Another alignment is necessary to level the bottom of the battery compartment, due to the change in the level of the vehicle battery box, when loaded or empty. In fact, this part of the vehicle sinks several inches by reason of the compression of the springs and pneumatic tires.

The vehicle is run into this position with the rear door open, and when thus aligned and leveled is ready to have its tray of batteries pushed from the table into the battery compartment or pulled out of the latter on to the table. These operations are performed by means of hydraulic rams from a point centrally located behind the table. This hydraulic machinery is shown in the illustration.

Under each of the two parts of the moving vehicle platforms hydraulic cylinders are vertically placed. The plungers are attached to suitable raising bars, upon which the vehicle body rests while loading. These parts are normally below the surface of the platform, but when actuated are projected through an opening about in the centre of each half, which is covered by a series of small hinged trap-doors. These rams raise the vehicle, and when the elevating plunger parts are projected upward, the battery compartment is raised clear of the springs by the one and the hansom body by the other. After the vehicle body has been lifted, which constitutes the first operation, the side alignment is accomplished by means of other rams operated on either side of the loading platform. These bars act at about the hub centres of the wheels and extend horizontally so as to strike both steering and driving hubs close to each end. The bars are connected to the plungers of the horizontally placed ram cylinders.

The two centring rams attached to each bar have dif-

ferent movements, the one opposite the front wheel having a travel of 11 inches, and the other one 7 inches. Both the lifting and centring rams act in one direction only, being returned to their normal position by heavy weights. The hydraulic rams and lifts are all mounted on solid masonry piers, and their movement is a definite predetermined amount, and raises and centres the vehicle to exactly the desired position.

In the rear of the conveyor table, placed horizontally in line with the centre of the loading platform, is a long hydraulic pushing and pulling ram; its cylinder is on a level with the top of the conveyor table, across which the long plunger is projected, and in the loading operation simply pushes the tray into its compartment. If the battery is to be unloaded the plunger is extended so that a pair of hooks at its ends automatically engage with sockets on the end of the tray, and the return of the plunger pulls the tray on to the conveyor table. The hooks are released by means of a lever at the rear side of the table, which is accessible to the man in the crane cab. After loading or unloading, the hydraulic machinery is returned to its normal position, and the vehicle leaves the platform.

Having carried the battery to the conveyor table, the crane operator finds himself directly in the centre of the latter, and at this point are the handles for its manipulation and the valves controlling the hydraulic cylinders, all of which can be operated without stepping from the crane cab. His position in the crane cab enables him to easily watch the lamps on the charging panels. The batteries are transferred from one line to another by bringing them to the conveyor table and shifting them in line with any hoist. The crane, which was made by William Sellers & Co., of Philadelphia, is operated by Westinghouse four-pole motors, each of 5 H. P. capacity. This arrangement makes all the motors interchangeable. For the operation of the crane bridge and the conveyor table a double motor equipment is used, which further insures continuous operation. The current for the crane motors is taken from the trolley wires suspended above the crane bridge.

For the operation of the hydraulic machinery an electrically operated Gould triplex pump is used. This pump is placed at the wall end of the conveyor table and feeds a pressure tank, from which pipes are extended to the various controlling valves, located as has already been described. The water is taken from a tank 3 feet in diameter and 5 feet deep, sunk in the floor between the loading platforms, and is returned after being used. The working pressure is 150 pounds to the square inch.

In addition to the loading stations just mentioned, an emergency loading station has been provided at the side of the battery room between the two vehicle elevators. No arrangement is made at this station for side centring, but the lifts and loading cylinders are arranged as in the others. At this station the battery tray is carried on a car to the rear of the vehicle, where it is handled by a loading and unloading ram, as previously described. The tray-carrying car runs on a track extending from this loading station transversely across the battery room, and the handling of the battery by the crane from and to the car will be obvious from prior description. The car with one tray can be set in line with any of the eight rows of battery racks.

The operation of the elements of this machinery is greatly aided by a number of interlocking safeties. On the crane an interlocking device coacts with notches in the track girder and only permits of operating the hoists when they are properly centred over the battery racks or the conveyor table. The hoisting motors are also locked with the crane bridge motor, so that the latter can only be operated when all the hoists are up and clear from obstruction. The conveyor is provided with automatic motor stops at each end, so that the battery cannot be carried over the ends, and it is also interlocked

with the loading machinery, so that the conveyor can not be moved when the loading ram is in action, or vice versa.

There are two vehicle elevators operated by worm gear electric motor drum hoisting machines. Each elevator has a capacity of $2\frac{1}{2}$ tons and operates at the rate of 100 feet per minute. They are controlled by rope-operated starters.

Aside from the loading and unloading, the handling of the vehicle is simply a matter of unskilled labor. If the vehicle is to be stored after unloading, it is washed as any other carriage would be and sent to the upper floor by the rear elevator. As the vehicles are wanted they are lowered by the forward elevator. Each cab is inspected by the starter before leaving the station and a record taken of its battery equipment.

With the desire to increase the efficiency of the service, a series of vehicle tests will shortly be inaugurated. This will include tests of current consumption under different conditions of running, speed on grade and level, and traction tests. Various special and standard instruments have already been arranged for this purpose.

Rates of electric cab hire are about one-half those of the horse-drawn service; for each single passenger 30 cents for the first mile and 15 cents for each succeeding mile is charged, or the cabs may be hired by the hour at special rates.

The Electric Vehicle Company's officers are: Fred. Vieweg, general manager, and G. Herbert Condict, chief engineer. The superintendent of the plant is W. T. Headley, and the constructing superintendent, A. W. Gilbert.

CONDUCTORS.

TRANS-AFRICAN TELEGRAPH LINE.

A telegraph line from Cairo to Cape Town, in Africa, is talked of, with Mr. Cecil Rhodes as chief promoter, according to "The Engineering and Mining News." The proposed route would be from Fort Salisbury to the Zambesi, near Tete; thence to Zomba and along the west coast of Lake Nyassa to Karonga and Lake Tanganyika. At the latter point it would be necessary to lay a cable to the head of the lake, or obtain the permission of Germany or the Congo State to run an overland line through that territory. A telegraph line is now said to extend as far north as Lake Tanganyika; and from Cairo south it almost reaches the site of old Khartoum, or the junction of the Nile and the Atbara.

VACUUM TUBE LIGHTING.

VACUUM TUBE LUMINOSITY.

Mr. Ewin S. Ferry's communication to the "Physical Review" on the relations between pressure, current, and luminosity of the spectra of pure gases in vacuum tubes is a most valuable one. The author describes his methods fully, and gives his results in a series of tables and curves, which lead to the following conclusions regarding the luminosity of the separate spectral lines of gases in vacuum tubes under different conditions of pressure and current strength: (1) With gas pressure of from 0.25mm. to 4.00mm. of mercury, and current strengths of from one milliampere to six milliamperes, the luminosity of the separate spectral lines of gases at a given pressure is directly proportional to the current strength. This is in exact parallelism with K. Angstrom's observation that the energy of the luminous radiation, as well as the total radiant energy of a gas rendered luminous by an electric current, is directly proportional to the current strength. (2) With constant current, the luminosity of a spectral line of a gas increases as the

pressure decreases, at first slowly and then more rapidly. The curve showing the relation between the pressure of the gas and the luminosity of a spectral line is regular, but is different for different lines. The research work was performed in the Physical Institute of the University at Upsala, and in conclusion the author expresses his deep obligations and grateful thanks to Prof. Knut Angstrom for the assistance and encouragement he received from him throughout the entire course of the experiments. To experimenters in vacuum tube lighting the possession of exact data is invaluable. The illuminating power of a gas as compared with the electrical energy consumed to produce that illumination being known, the problem of vacuum tube lighting at once assumes a position relieved of empiricism. A volume on vacuum tube lighting, its past and present, would be well received by the profession. The English Electrical Engineer, by interpreting the above, have certainly placed many readers of electrical literature under obligations to them.

WATER POWER INSTALLATIONS.

LONG-DISTANCE POWER TRANSMISSION PLANT

A contract involving 10,000 H. P. to be transmitted over a distance of 45 miles, and further stipulating that the losses in generators, transformers and line shall remain normal, notwithstanding the difficulties involved, has just been executed by the Westinghouse Electric and Manufacturing Company. The plant is for the Snoqualmie Falls Electric Power Company, of Snoqualmie Falls, Washington. The power station is to be located at Snoqualmie Falls, 45 miles from Tacoma and 31 miles from Seattle, to which places the current is to be transmitted and then utilized by Westinghouse motors. The contract involves the building and delivery of four three-phase rotary armature generators, having a normal aggregate capacity of 6,000 kilowatts, and which are to be direct-connected to water wheels; two 75 kilowatt kodak exciter dynamos, also to be direct-connected to water wheels; high and low potential switchboards for main power station and sub stations at Seattle and Tacoma, requiring 76 marble panels, with all necessary instruments, switches, etc.; high-tension oil-insulated static transformers, having an aggregate capacity of 10,875 kilowatts; rotary transformers, with a total output of 2,700 kilowatts, and 6 type C motors, developing 1,600 H. P., with adequate lightning protection at both ends of the line. These machines, when installed, will make available for industrial, railroad and lighting purposes the power of Snoqualmie Falls. The line potential will be 25,000 volts, and its current will be carried over bare aluminum wires to sub-stations, where lowering transformers will sufficiently reduce the voltage for safe transmission within the corporate limits of the two cities. The "Engineering and Mining News" prints the above. The use of aluminum conductors marks a decided innovation in power transmission plants.

ALTERNATING CURRENT MACHINERY.

"TRANSFORMER ECONOMY."

By Professor Goldsborough, of Purdue University, Lafayette, Indiana.

The new company has been in operation two years, and its plant is thoroughly up-to-date and highly efficient. Oil-insulated transformers of from 80 to 200 lights' capacity are used, and are kept in continuous service. The transformers are of modern design and stand an insula-

tion test of 7,000 volts, without oil. The lines of the new company run over those of the old company and are protected about every 1,500 feet by lightning arresters. None of the secondaries of these transformers are, however, grounded, and magnetic shields are not used. The new company has never experienced any trouble from burnouts of any kind, although its lines are very much exposed. In a very violent electric storm which occurred some time since, in which the service of the old company suffered in consequence of transformer burnouts, the service of the new company was not interfered with in any way, although lightning struck the lines several times.

There has been a great deal of interest expressed recently in the effort to formulate a definite set of specifications covering the construction and insulation of transformers, with the end in view of decreasing the fire hazard and supplying the necessary protection from loss of life and property to both the producer and consumer of electrical energy.

In a letter that I have lately received from a gentleman who is much interested in the success of this project, he says that after corresponding with a number of makers, engineers and lighting companies to obtain suggestions as to the remedies for the troubles arising from crosses, lightning, insulation, break-downs, etc., the results were very unsatisfactory, as there seemed to be a vast difference of opinion.

I have read a great many articles for and against the use of earthing devices, grounded shields and grounded secondaries, but I am yet to be convinced that the prominent American practice of high insulation resistance to a disruptive discharge and a plentiful use of well-grounded short air-gap lightning arresters does not give a sufficiently good protection.

As I have already remarked, the number of modern transformers that are reported as burning out is relatively very small. By far the greater portion of the troubles arise from crosses between the high and the low potential circuits, and in such cases the loss must be attributed to faulty installation and not to any imperfection in the transformer.

An oil-insulated transformer for use on 2,500-volt primary circuits, or less, having a maximum temperature at full load not exceeding 65 degrees C. and designed to stand an insulation test without oil of 750 volts for five minutes, and a prolonged test of 10,000 volts with oil, will be in slight danger from lightning discharges if protected within a distance of 500 feet by a properly installed lightning arrester.

A transformer should also be able to stand a double primary potential test for five minutes, and the insulation test should be made between the coils and between each coil and the core.

In the case of transformers to be used exclusively on very high voltage circuits these considerations do not apply, nor should this paper be considered as dealing with this class of alternating apparatus, which has come to form a department by itself.

In considering the economy of transformers, the problem before us is not so much a discussion of their efficiency as a converter of electrical energy, as it is a discussion of this efficiency in connection with the numerous extraneous causes that tend to make the transformer a menace to life and property.

To my mind a great deal would be gained if an understanding could be brought about between the makers and purchasers of transformers that would result in a uniform practice in the several departments of transformer design. The manufacturers would work to better advantage by having definite specifications to work to, and the way would be open for a bonus or forfeit in equitable proportion to an excess or shortage in the economy of the product. The fad at present tends to over protection. It is bad practice to run to extremes in any department of engineering, and too much protection may turn out to be just as costly as too little.

ELECTRIC STREET RAILWAYS IN EUROPE.

On January 1st, 1898, there were 204 lines of electric street railways, with a mileage of 2,259.4 kilometers in operation in Europe. The rolling stock consisted of 4,514 motor cars. Germany has 65, France 44, Austria-Hungary, 13, Great Britain 24, Switzerland 23, and Italy 11, electric street railways. The system most in use is the overhead trolley, which is operated by 172 lines, while 8 lines have adopted the underground trolley, 8 lines the third-rail system, 13 lines storage or accumulator cars, and 3 lines have a mixed system of overhead trolley and accumulators at certain points of their lines.—U. S. Consul-General De Bois, Switzerland.

STREET RAILWAY NEWS.

Annapolis, Md.—A new electric railway is to be built to run from Baltimore through Anne Arundel County to Gibson's Island or Mountain Bar. Capital stock of the company is placed at \$50,000.

Richmond, Va.—City Clerk of King William may give information concerning proposed erection of electric railway from Richmond through Henrico, Hanover and King William.

Portland, Ind.—The Portland & Camden R. R. Co. has been incorporated by Frank S. Vine, James Droege and others; to operate an electric railway between Portland and Camden. Capital stock, \$50,000.

St. Louis, Mo.—The Electric Connecting Railway Co. has been incorporated by John H. Bobring, J. D. Houseman, Jr., and others; to build and operate an electric line to Kimswick and De Soto. Capital stock, \$2,000.

Gaston, Ind.—Ozora Sharp is reported to be interested in the construction of an electric line in this city.

Millbury, Mass.—The construction of the new electric road between Grafton and Worcester has begun.

Grand Rapids, Mich.—An electric road between Grand Rapids and Belding is being talked of.

POSSIBLE INSTALLATIONS.

Crescent City, Fla.—The Pierpont Manufacturing Co. has been granted an electric light franchise for a term of twenty years, the town having the privilege of purchase at the expiration of ten years.

Kingwood, W. Va.—City Clerk may be addressed concerning establishment of electric light plant.

Pratt City, Ala.—P. C. Shook and others have been granted franchises to erect an electric light plant, etc. The plant will cost about \$10,000.

Florence, Ala.—The Florence Milling Co. contemplates establishing an electric light plant.

Opelika, Ala.—The Mayor may be addressed concerning contemplated erection of electric light plant.

Dalton, Ga.—City Clerk may be addressed concerning establishment of electric light plant.

Sturgis, Ky.—City Clerk will give information concerning establishment of an electric light plant.

Oakland, Md.—The Mayor may be addressed concerning purchase of electric lighting plant, for which \$25,000 has been issued.

Asheville, N. C.—F. M. Miller, Mayor, may be addressed concerning contemplated purchase of electric light plant.

Lumberton, N. C.—E. K. Proctor, Jr., Mayor, may be addressed concerning erection of electric light plant.

Wharton, Tex.—G. C. Gifford has been granted franchise for lighting and water supply, and will at once arrange for erection of electric light plant.

Fredericksburg, Va.—The Mayor may be addressed concerning erection of municipal electric light plant.

NEW INCORPORATIONS.

Trenton, N. J.—New Jersey Washington Light Co. has been incorporated by E. Raymond Perrine, Richard H. Page, Horace M. Royal and others; to operate a system of lighting. Capital stock, \$100,000.

Lincoln, Ill.—The Lincoln Gas Co. has been incorporated by F. B. Ferguson, George Skinner and others; to furnish gas and electricity. Capital stock, \$10,000.

McKinney, Tex.—The McKinney Electric Light & Motor Power Co. has been incorporated by L. A. Scott, J. T. Nunely and D. T. Perdue. Capital stock, \$17,000.

Philadelphia, Pa.—International Incandescent Light Co. has been incorporated, with a capital stock of \$1,000,000.

Elizabeth, N. J.—The American Auto-Mobile Company has been incorporated, with a capital stock of \$500,000; to manufacture motors and other electrical devices.

TELEPHONE CALLS.

Albion, Mich.—The Calhoun County Telephone Co. has commenced operations.

Urbana, Ohio.—The Urbana Telephone Co. has been incorporated by D. B. McDonald, Edward L. Barber, James S. Bradley, Jr., J. H. Dimond, E. M. S. Huston and others. Capital stock, \$30,000.

Washington, Ga.—Ben A. Neal and Clark Grier have obtained franchise for, and will construct, a telephone system in Washington.

BUSINESS CHANGES.

Stevens Point, Wis.—The Stevens Point Lighting Co. plant has been placed in the hands of a receiver.

Chicago, Ill.—Diamond Electrical Co., manufacturers of electrical supplies, closed on executions, \$10,000.

Troy, N. Y.—The Hudson Electric Light & Power Co. has passed into the hands of Charles J. Cooper, of Brooklyn.

EXTENSIVE WATER WORKS DEVELOPMENT AT KANAWHA FALLS, W. VA.

Every arrangement has been completed, says the "Manufacturers' Record," for the development of the water power of the Kanawha Falls, located near Hinton, W. Va., and the work is now progressing rapidly under the direction of Mr. John W. Hayes, of Petersburg, Va.; Mr. Hayes also prepared the plans for the development.

The power is being developed by the Wilson Aluminum Co., of 97 Cedar street, New York. This corporation began operations several years ago at Spray, N. C., where it was the first to manufacture the calcium carbide now so extensively used in the production of acetylene gas. The company's business outgrew the power at Spray, and then a removal was made to Holcomb Rock, Va., and when it was seen that this power would not suffice it was determined to develop the power at Kanawha Falls, as noted above.

It is proposed to make two developments at the falls, 2,000 horse power to be developed on the north side and 5,000 on the south side, and it is stated that the conformation of rock about the falls renders this dual development expedient. The Kanawha River at the falls is about 1,600 feet wide, and is crossed by that hard ledge of sandstone known as the "Homestead," of Pennsylvania. The ledge forms an island rock rising six to eight feet above the water on the upper side of the falls and about twenty-six feet above the water below the falls, extending across the river, except at each side, where the river passes through a narrow channel and plunges over the crest of the ledge in falls of twenty feet height. At each of these falls the natural dam formed by the great rock will be completed by masonry and a head of twenty-six feet developed. The power of the Kanawha here is about 8,000 horse power (actual), varying from 6,000 to 12,000, with short seasons of greater variation.

The constructors are now engaged in extending the natural dam across the north side of the river, and this section is all that will be undertaken this season. A part of the season's work will be the installation of the wheels and the erection of the buildings and machinery necessary for the manufacture of calcium carbide. It is probable that the Wilson Aluminum Co. will require all the power developed for its own use, and therefore no electricity will be furnished to other industries.

"When times are dull and people are not advertising," says John Wanamaker, "is the very time that advertising should be the heaviest." Ninety-nine out of every hundred merchants advertise when there is least need of it, instead of looking upon advertising as the panacea for their business ills.—New England Editor.

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With your invention? Why can't you get capital? We will tell you. You require endorsement by competent experts; we have them. If your invention has merit, our endorsement will enable you to get capital. Try us. Fees moderate. Correspondence solicited.

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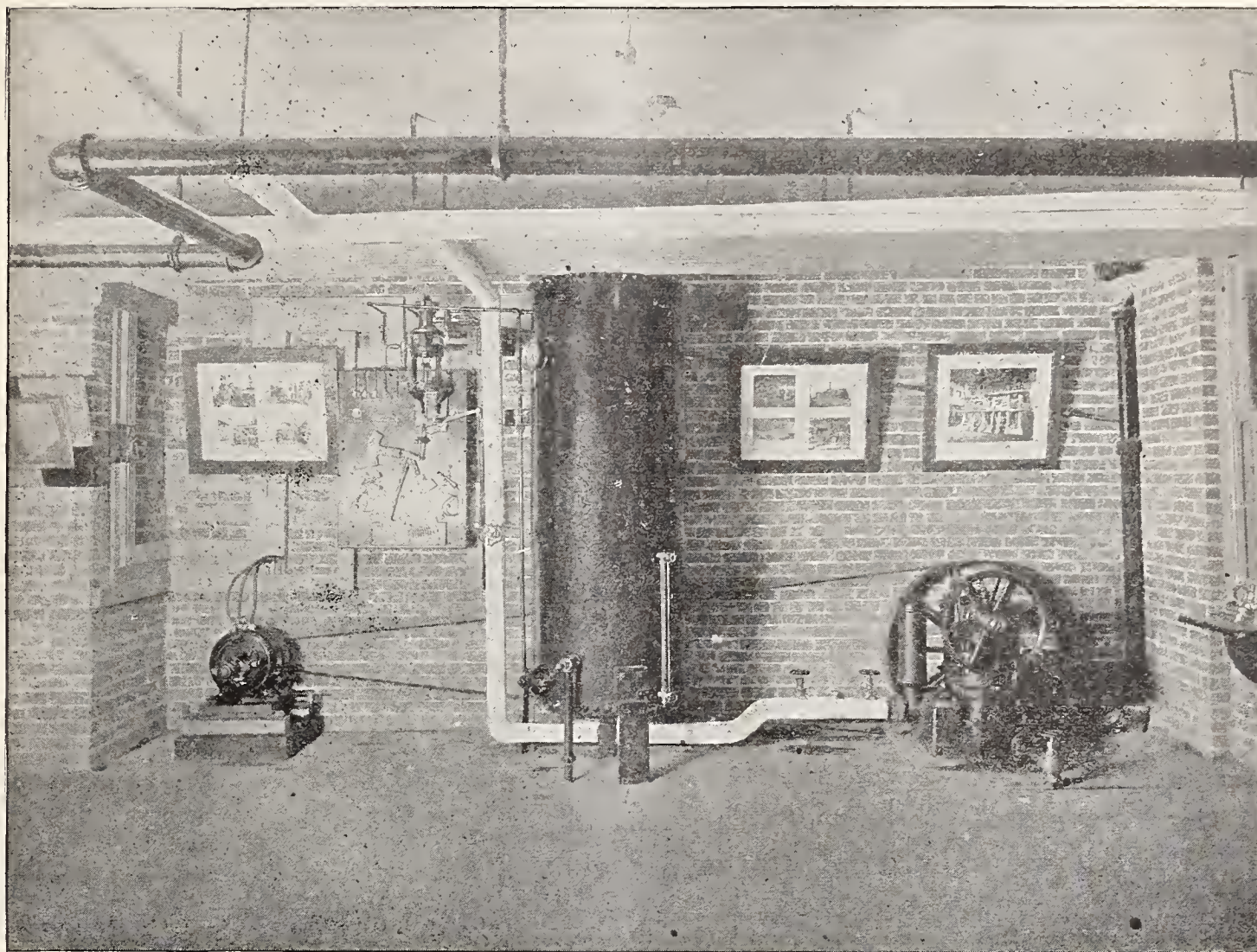
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WESTON ELECTRICAL INSTRUMENT CO.
114-120 WILLIAM STREET, NEWARK, N. J.

ELECTRIC PUMPS.



Automatic Electric Pump—Compression Tank System. Goulds Electric House Pump, Driven by Lundell Motor, Supplying Water to the Offices and Also to Operate the Automatic Elevator Gates in the Ferguson Building, Detroit, Michigan.

ELECTRIC POWER PUMPS.

The application of electricity for the operation of pumps has become a fixed part of engineering practice. A variety of purposes open up new and broadening fields, in each of which the electric pump finds a permanent position. Pumps may be used in connection with domestic service, in the engine room, in the mine, and for many other purposes. To enumerate, the following applications present themselves, in which pumps direct-connected to electric motors are operated noiselessly and economically. Pumping may be done with the electric house pump, the electric pump for hydraulic elevators, the electric pump supplying water to mills and factories, the electric boiler feed pump, the electric fire pump, the electric pump for mining. It may also be used for electric fountains, and in certain other instances it operates with a success that admits of no criticism.

The automatic electric house pump, run by a Crocker-Wheeler motor, connecting with a Goulds triplex pump, having a capacity of one thousand gallons per hour, has been installed in the Scarborough Mansion, 221 W. 57th street, New York City. The open-tank system is employed in this case, as in any other where the tank may be placed in the upper part of the building, and is there supplied with a float and chain connecting with an automatic switch. The rise and fall of the water switches the current off and on through the medium of the float.

By the compression-tank system, which is used in hotels and office buildings, a closed tank is situated in the basement, adjacent to the pumping outfit. Both water and air are pumped into it, the air pressure in the tank

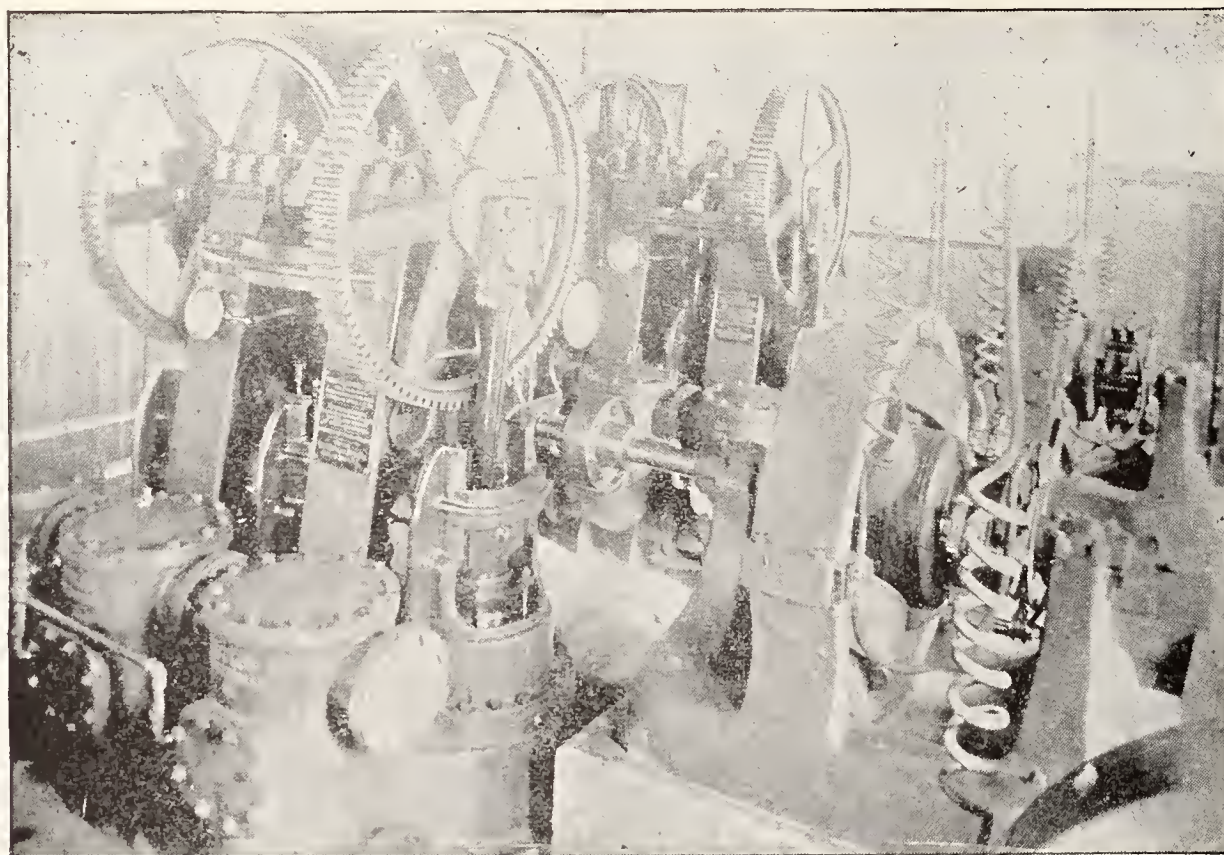
forcing the water to the upper floors when required. The compression-tank system, consisting of a tank, Goulds' electric house pump, driven by a Lundell motor, and a small switchboard, has been installed in the Ferguson Building, Detroit, Mich. This system is excellent for supplying drinking water to offices. Outfits of from one hundred to twelve hundred gallons per hour can be readily procured.

For elevator pumping there is nothing superior to the electric pump. It is perfectly automatic, requires no care, and invites no additional cost. During the hot weather neither the boiler nor steam pumps need be kept going, the triplex electric pump taking care of itself. The two plans adopted for the control of automatic electric pumps are called the by-pass and the start and stop. With the elevator in constant use the by-pass is preferable. In this case both motor and pump are constantly operating. When the elevator is not in use the by-pass relieves the load. The start and stop plan is best if the use of the elevator is inconstant. In this case the pump and motor only run when the elevator is in use.

In the Berkshire County Savings Bank Building, Pittsfield, Mass., a modern elevator pumping system has been installed, in which Gould's triplex electric pump is driven by a Stanley alternating-current motor. In the city of De Kalb, Ill., near Chicago, the water supply has been pumped lately by Gould's electric pumps. The original cost with steam pumps was ten cents per thousand gallons. It is now less than five cents. Two triplex pumps are used, each respectively of seven hundred

and fifty thousand gallons' capacity per day. General Electric motors are in use in this place. The electric light plant supplying power to this pumping station switch on the pump load when the stations are at light load.

Street railways frequently increase their traffic by providing places of amusement for the people; the opening of parks and sea-side resorts and the running of electric fountains being included. In Willow Grove Park, near

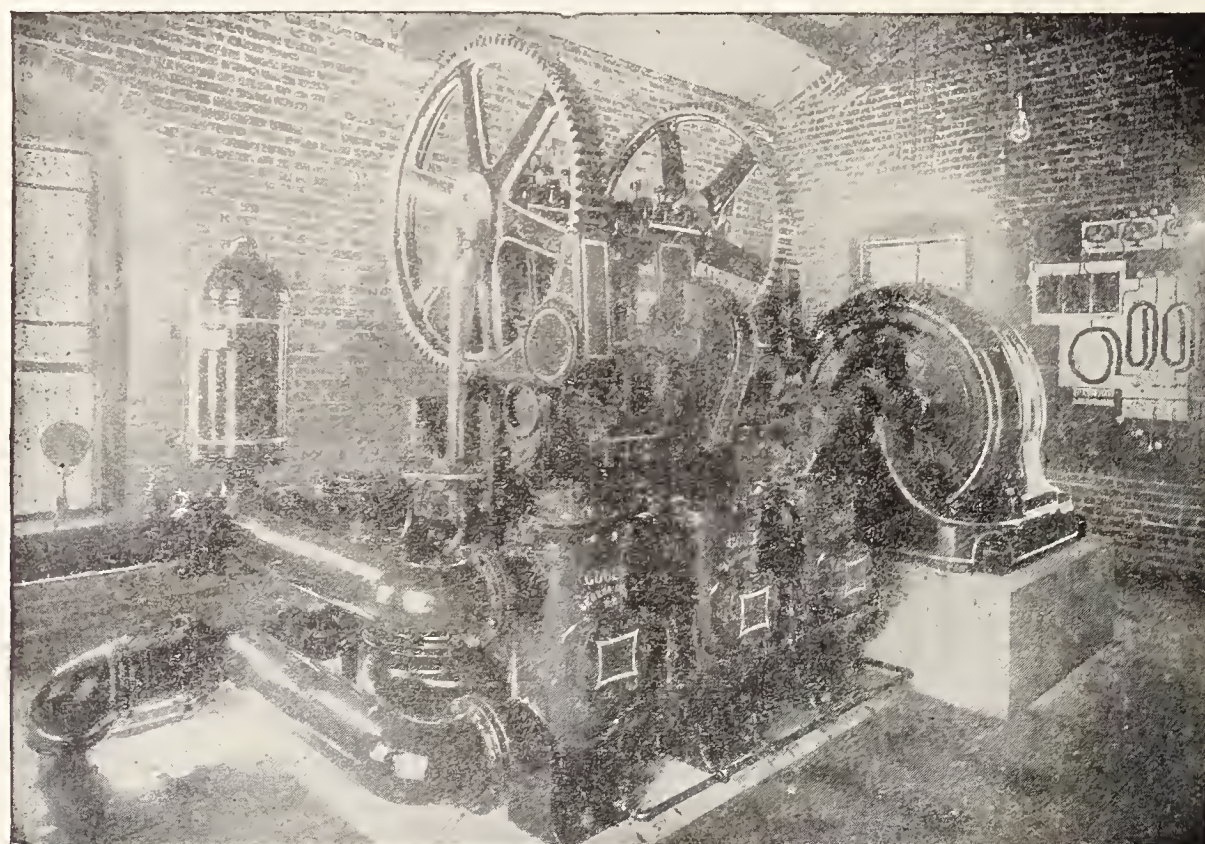


Electric Pumping Plant at De Kalb, Ill.

This means economy to them in running expenses and a reduced cost to the city of De Kalb.

When used as a fire protection, Goulds' electric fire pump saves considerable expense, inconvenience and risk. A pump of this description has been installed at Itaska,

Philadelphia, the Union Traction Company, of that city, have built a beautiful electric fountain. It was designed by F. W. Darling, and the water is pumped into it by Goulds' triplex electric pumps, operated by two General Electric street railway motors. These motors are controlled in



Goulds Electric Fire Pump at Itasca, Wis., in the Freight House of the Chicago, St. Paul, Minneapolis & Omaha Railway.

Wis., in the freight house of the Chicago, St. Paul, Minneapolis & Omaha Railroad. The severest tests have given favorable results. The freight house has connected at different points in its interior an electric switch and reel of hose, by means of which current can be turned and the pump operated at a moment's notice. Current is transmitted from the railway, about a mile and a half away. In every respect this installation has been successful and not caused one dollar of additional expense.

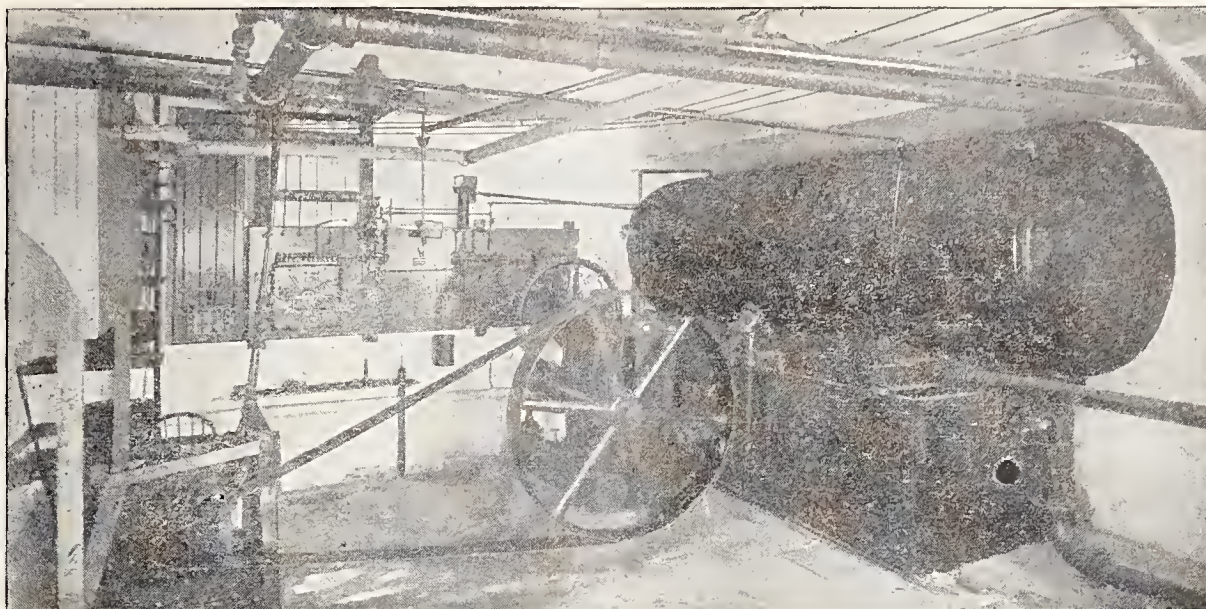
speed and capacity by rheostats, so that the output of the pumps equals eighty thousand gallons per hour. This application of electric pumps to fountains has so pleased the people's aesthetics that they are being erected in all of our large cities.

In connection with gas engines, the Goulds power pump has seen considerable service. In the case at hand, the Wyandotte Building, Columbus, O., a forty-horse-power gas engine drives a large Goulds double-acting pump.

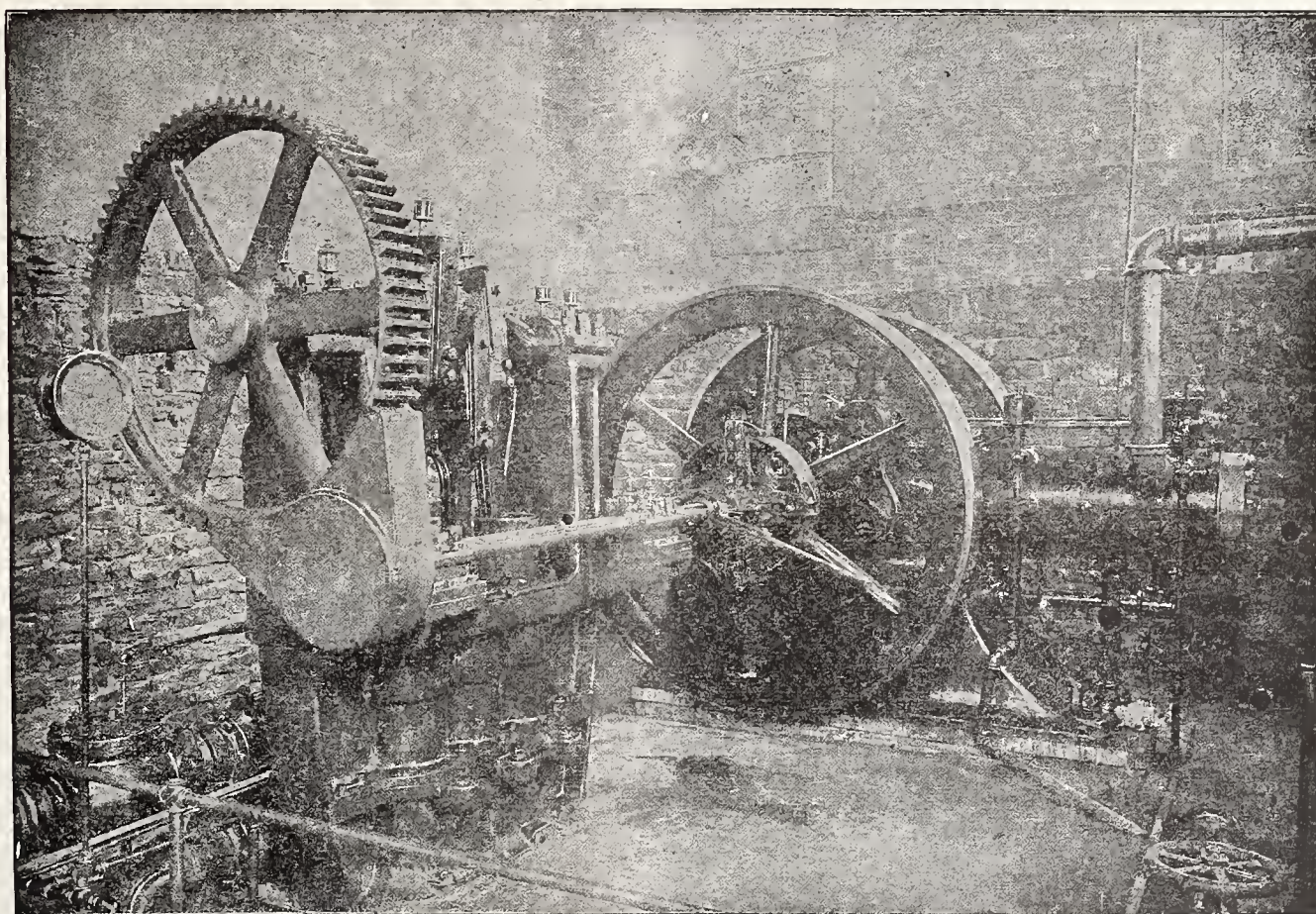
Natural gas is used in this case, costing only eighteen cents per thousand cubic feet. Two Otis elevators, running through seven stories on a one-minute schedule,

are in constant use. The total expense for gas does not exceed \$12.00 per month.

This exceptional case is noted, though not strictly



A Model Elevator Pumping System in the Berkshire County Savings Bank Building, Pittsfield, Mass. Installed by The Plunger Elevator Co. Goulds Triplex Electric Pump Driven by a Stanley Motor.



Goulds Triplex Power Pump, Capacity One-half Million Gallons Daily, at Lake Mills, Wis., driven by a Gasoline Engine, built by the Dayton Gas Engine Manufacturing Co. A Model Water Works Plant.



Goulds Electric Fire Pump at Itasca, Wis., in the Freight House of the Chicago, St. Paul, Minneapolis & Omaha Railway.

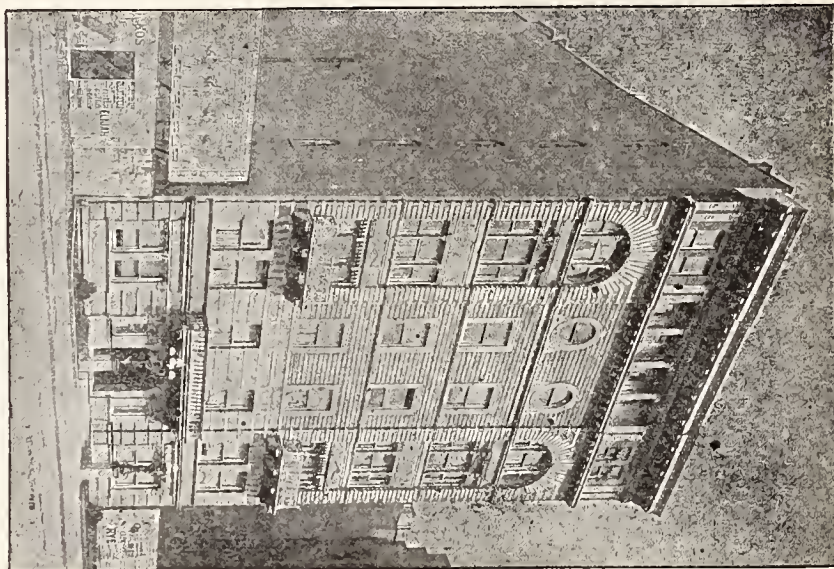
speaking, of interest to electricians, yet to those living in localities where natural gas is supplied the advantages are obvious.

The Goulds electric pumps are manufactured at Seneca Falls, N. Y.; the Boston office is at 8 Oliver street, the Chicago office at 22 and 24 North Canal street, and the New York office at 16 Murray street.

THE TRANSMISSION OF ELECTRICAL ENERGY.

A FRENCH VIEW OF ELECTRICAL POWER TRANSMISSION.

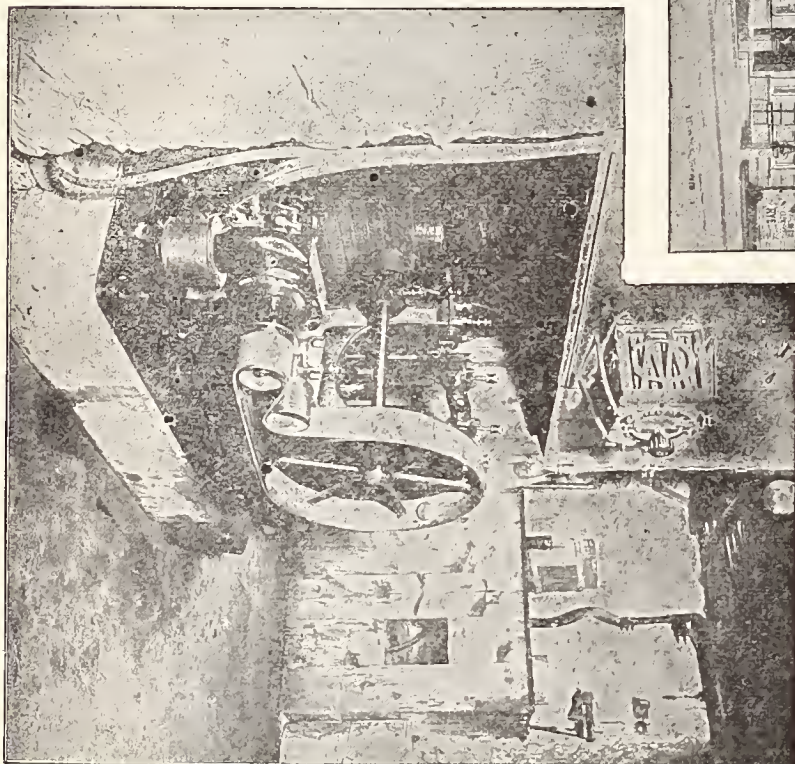
Writing in the "Revue Générale des Sciences," M.



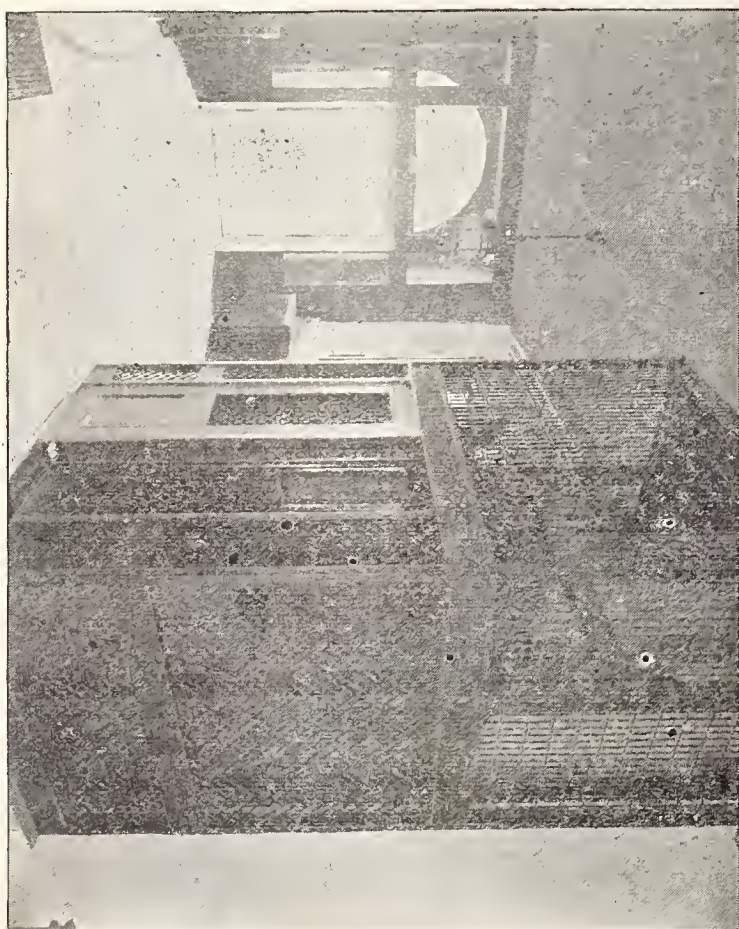
Paul Janet would have every workshop, every warehouse, and even every workman's lodging or home provided with necessary power from some central point where such power can be produced under the best and most economical conditions. Other systems of power transmission, by cable, compressed air, water, all have their disadvantages; but the discovery of the reversibility of the dynamo gave a new aspect to the whole question. The efficiency of a transmission is reduced by three losses, which, to give fixity of idea, are set down as 10 per cent. in the generator, 10 per cent. in the receiver, and an

amount in the line represented by $p = \frac{R P r^2}{E^2}$, where R

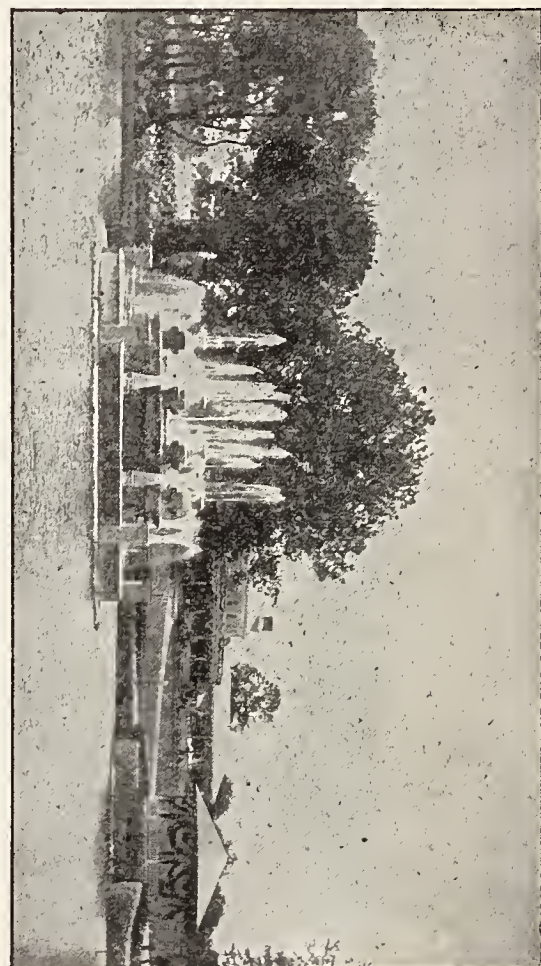
$$p = \frac{R P r^2}{E^2}$$



Goulds Triplex Electric House Pump with Crocker-Wheeler Motor. Capacity, 1,000 Gallons per Hour. In "Scarboro Mansions" 221 West 57th Street, N. Y.



Hydraulic Elevator Operated by Triplex Electric Pumps.



Electric Fountain, Willow Grove Park, near Philadelphia, Pa.

Iron City, Tenn.—The Lawrence Telephone Company is being organized.

is the line resistance in ohms, P is the power in watts, E the voltage, and r is the efficiency of the generator.

The Electrical Age.

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THE ENERGY OF A LIGHTNING FLASH.

Higher and higher potentials are being used in power transmission plants. Pressures that could not have been handled with any degree of practical success are utilized and guided with perfect safety between points situated ten, twenty or thirty miles apart. Insulators have been improved in quality of late and can withstand potentials of thousands of volts without failure or depreciation of any kind. There is, of course, a limit to the use of very high pressures. The danger of sparking becomes very apparent when the pressure reaches fifty thousand volts. A power transmission line is more or less efficient, other things being equal, depending upon the pressure. The greater the pressure the greater its efficiency, and the lower the pressure the converse, unless a heavy conductor is used. The risks of leakage and the danger of sparking increase together. A pressure of thirty thousand volts is required to spark across a distance of one inch. But conditions have so much to do with the sparking distance that it might be safer to regard forty or even fifty thousand volts as the potential which will burst through a distance of one inch.

The sparking distance is affected by the nature of the light to which the terminals are exposed, as well as the pressure and temperature of the surrounding atmosphere. Electrostatic discharges a mile in length represent a pressure of millions of volts and a current strength of at

least one hundred amperes. A flash of lightning one mile long means a pressure of discharge equal to three billion volts, if the basis of estimate is fifty thousand volts per inch of space. Although fifty thousand volts may be used in this calculation, it does not necessarily follow that a five-inch spark is produced by one-quarter of a million volts. If, however, a lightning discharge one mile long actually means a potential of three billion volts, possessing a current strength of one hundred amperes and lasting for one one-thousandth part of a second, the energy dissipated by the discharge equals three hundred thousand horse power. The amount of energy dissipated depends upon the electromotive force of discharge, the current strength and the period of time through which it lasts.

It is very likely that lightning discharges have occurred which meant the dissipation of at least one-half a million horse power, and possibly in some cases a million. We measure horse power by the rate at which energy disappears or is transformed. Consequently a tremendous outburst lasting for a fraction of a second is not of such awful consequence from a cold scientific standpoint.

Our present system of lightning rods is one which, strange to relate, forces a discharge to leave the earth in that given locality. The lightning rods force a discharge upward and, in certain respects, act homœopathically towards the surcharged aqueous vapor above. The multiplicity of these in the city in some way relieves each rod individually of the danger of fusing during a thunder storm. Another reason is one which brings in the element of time; the heating of a metallic body requires such time that even though a perfect avalanche of power is brought to bear upon it for a thousandth of a second, the time, if insufficient, will not cause fusing, although the energy applied for the instant would, if continued, resolve the body into its constituent atoms.

An interesting and valuable addition to our technical literature would consist of the results of experiments devoted to the discovery of the electromotive force required to cause a disruptive discharge between terminals exposed to ordinary light and the normal atmospheric pressure.

DYNAMOS WITHOUT MOVING WIRES.

It is considered a triumph of engineering to have constructed a dynamo without commutator or moving wires. The modern inductor alternator is just such a type of machine, and for practical utility and other obvious qualities has become an important factor in the application of electricity to lighting and power. The return from the more complex types of mechanism to the simpler is most natural. The ideal dynamo is certainly one simple in construction and durable in character. In the effort to attain other ends the dynamo, all types of which today are inherently alternators, were modified by the use of a current-rectifying commutator. Continuous-current machinery came into vogue, and this department of engineering represented all progress until the use of simpler alternating-current machinery, the application of polyphase currents and the invention of a system and motors for the distribution of such power added tremendous impetus to this new, though old, field.

Alternating currents were recognized as the most desirable for power-transmission purposes, and the employment of polyphase motors crowned this work with success. The inductor alternator came to the front and became recognized as an addition of tremendous value on account of its lack of commutator and the fact that no wires are moved during revolution. Out in mining camps, or in districts where engineering skill cannot be obtained, simple machinery counts for a great deal. This is one of the reasons why some inventor might turn his attention towards the construction of a continuous-current dynamo as commutatorless as the inductor alternator.

Thus, with a power of 100 H. P. (French), or, say, 73,600 watts, and 10 ohms of resistance with 4,000 volts, the generator output being 90 per cent., we get the percentage of line loss

$$p = \frac{10 \times 73,600 \times 0.81}{16,000,000} = 3.7 \text{ per cent.} \quad (1)$$

Hence the necessity of high voltage and small line resistance. The upper limit of the tension depends upon the possible difficulties in insulation of machines and of the line itself, difficulties which increase more rapidly than the tension itself. Losses from line are of two kinds, conductive and disruptive. The first are due to poor insulating material, and are most serious, being invisible, silent, and resembling the leakage of water from porous pipes. Damp air is the chief cause of such losses, or moisture on the line supports.

Disruptive losses may occur, no matter how dry the air, or how perfect the insulation, with a high tension. Disruptive discharges resemble the sudden rupture of a very impermeable water pipe, hard but fragile. There is a sort of electric fragileness. The subject was once

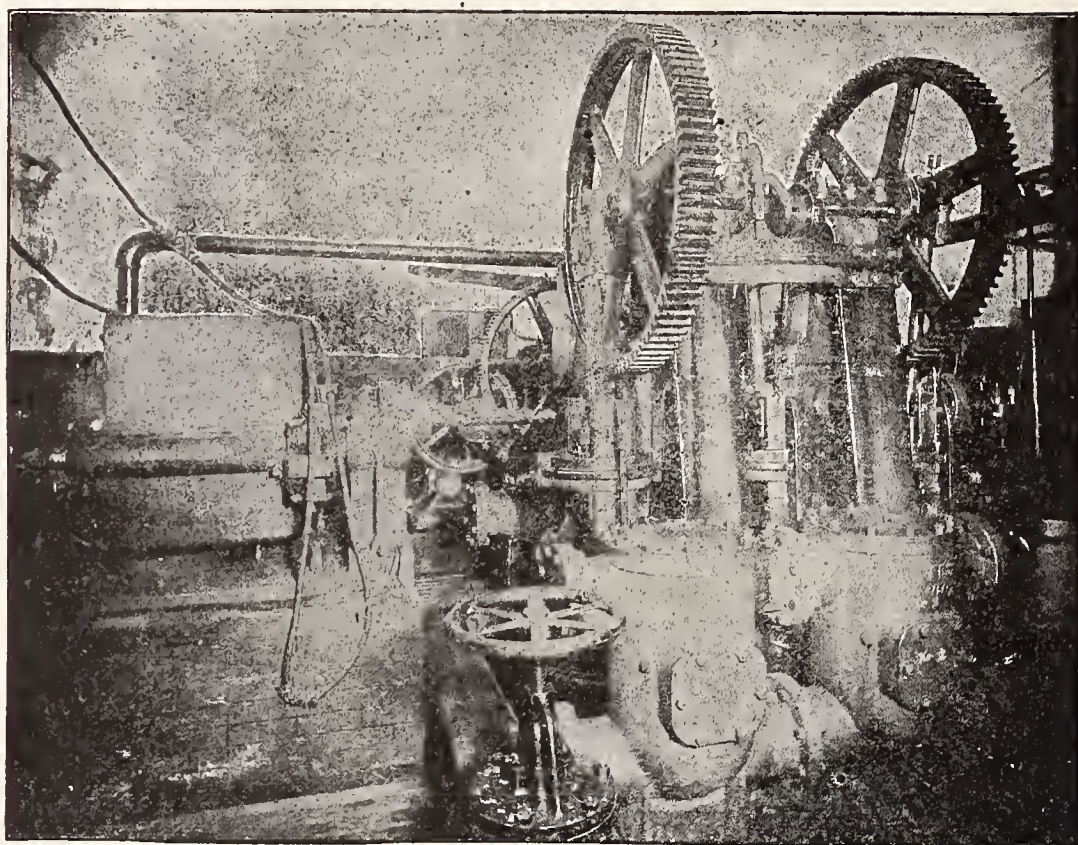
weight, and, therefore, the cost of a line varies inversely to the loss allowed, a heavy loss allowing an economy of copper, while a large locked-up capital in copper will reduce the line loss; hence Kelvin's law that "for a maximum economy it is necessary that the cost of the energy annually lost in the form of heating of the line should be equal to the interest and amortization charges of the capital represented by the copper in the line." The energy lost per second in the line is equal to $R I^2$ by Joule's law, I being the ampereage of the current. The cost of the energy lost annually is thus proportionate to $R I^2$, and may be represented as $k R I^2$. The weight and

therefore cost of line is proportionate to $\frac{d^2}{R}$. Hence in-

terest and sinking fund must be $k' \frac{d^2}{R}$. Applying Kel-

vin's law, we have in $k R I^2 = k' \frac{d^2}{R}$, whence

The property of the Union Traction Company. The Electric Fountain was designed by F. W. Darlington. Water is supplied by Goulds Triplex Electric Pump driven by a pair of general electric street railway motors, with speed-controlling rheostats, varying speed and capacity up to 80,000 gallons per hour.



looked on as rather in the domain of static electricity, and no fear was felt of disruptive discharges in the use of currents, but today electricians begin to encounter phenomena hitherto hardly seen outside the laboratory. Hence the necessity of limiting tension to about 20,000 volts. Line resistance can be diminished at will by increase of section. If d is the length in kilometres between two stations, the weight in tonnes of the two conductors will be

$$W = \frac{0.7 d^2}{R} \quad (2)$$

Thus for 10 kilometres and 10 ohms total line resistance

the weight will be $\frac{0.7 \times 100}{10} = 7$ tonnes, which, at

2,000 francs per tonne (£80) will make the line cost £560. Combining the two foregoing formulæ, it is found that

$$W = \frac{0.7 d^2 P r^2}{p E^2} \quad (3)$$

Thus for a given distance, power, and voltage, the

$R I = \sqrt{\frac{k'}{k}} d$. But the resistance of a line depends on its length, and is inversely as its cross section; thus

$$R = k'' \frac{d}{s}; \text{ whence } \frac{I}{s} = \frac{I}{k''} \sqrt{\frac{k'}{k}} = \text{const.}$$

Kelvin's law thus leads up to the remarkable result that "to obtain the best conditions and most economical, the quotient of the current intensity by the line section—*i. e.*, the amperes per square centimetre—should have a value depending on the price of copper and of mechanical power, and on interest and sinking fund, but altogether independent of distance. The complete for-

mula for current density is $\frac{I}{s} = \frac{1}{40} \sqrt{\frac{0.7 a \alpha}{100 p N}}$, where a

is the price of copper per ton (in francs), α is the interest, etc.; p the price per watt-hour; N the annual number of working hours. Thus, to take a concrete example, as at Niagara, with copper at 1,350 francs, and interest at 5 per cent., and the price of a H. P. per year

75 francs, the best current density will be found to be about 55 amperes per cm².

The principal elements of a transmission scheme are now easy to calculate. Choosing the tension as high as possible, the line current intensity is immediately deduced, since the product of the intensity by the tension to the power transmitted is to the output of the generator.

Kelvin's law then gives the best density to adopt, and there is obtained immediately the section of the line and its weight. These elements fixed enable the costs to be approximately established.

It is not possible to fix, exactly, the price of machines. They may be set down at 100 to 150 francs per kilowatt (£4 to £6). This enables the cost of generators to be given, while the small economy due to line loss need not be taken into account in calculating the motors in a first calculation.

For the line, copper of highest conductivity should be employed, and cost may be calculated at once from the market price, which will be higher than that of ordinary copper. To this must be added the pole cost, and insulators, posts being spaced at 50 m. apart, and valued at 25 francs each, with their insulators (£1). Thus a kilometer will cost 500 francs (£20).

Thus to transmit 200 H. P. to 10 kilometres at 4,000 volts, with, say, 10 per cent. loss at the generator, 7½ per cent. at the motor, and 12½ per cent. in the line, or a total loss of 30 per cent. (the losses are given all in terms of the motive power), the line must weigh

$$0.7 \times 100 \times 200 \times 736 \times 0.81$$

$$0.125 \times 16,000,000$$

= 4.17 tonnes by the formula (3), which, at a cost of £80 per tonne, will amount to £334, while the poles, &c., will cost £200, making a total of £534.* The generator will cost, at £4 per kilowatt, £588, and, neglecting the small economy of the smaller motor, this may be set down at the same price, or a total for the two machines of £1,176, or a total for machines and lines of £1,710, to which five per cent. may be added for apparatus, making a total of £1,795 for the mere electric plant. For this there will be delivered 140 H. P. at the motor terminals; the cost is thus nearly £13 per H. P. The cost of the same installation at only 1,000 volts would be about £48 per H. P. delivered, which is sufficient to show the extreme importance of the highest possible voltage.

At first sight the advantage of transmitting a water-power lies in the fact that the power costs nothing. Nevertheless, with possession of a water-power goes the necessity of constructing dams, channels, gates, tunnels, turbine houses, &c., all which when set down as capital at an annual charge for interest and depreciation may represent an expense comparable with the cost of fuel. A few examples are given from actual practice. No. 1. A fall of 100 metres and 4,000 litres per second in the Département de l'Isère. Power utilized 4,000 H. P.

The fall cost to acquire.....	£12,000
Dam, canal and pipes.....	10,000
Buildings and foundations.....	2,000
20 turbines of 200 H. P. each....	3,200

Total.....£27,200

The cost of power is thus nearly £7 per H. P. at the turbine shafts. In the Dpt. du Jura a fall of two metres, with 15,000 litres per second and 300 H. P. utilized, cost as follows:

Water rights.....	£1,800
Canal and building.....	6,000
Three turbines, each 100 H. P.....	1,200

Total.....£9,000

* 25 francs are translated as £1.

or £30 per H. P. at turbine shafts. These two examples are chosen as being particularly characteristic of extremes of high and low fall, and at once is seen the great benefit of using the maximum fall reasonably to be secured. In fact, nothing is so remarkable as the small size of turbines and plant necessary to utilize water at a high pressure. Of the first class of high falls may be cited the paper mills at Lancey, near Grenoble, where a fall of 500 m. has been utilized, while of the second kind the low falls of the Rhone, at Geneva, show what heavy work is necessary to utilize large masses of water at low falls.

Again, in Upper Savoy, a fall of 140 metres, giving a mean flow of 8,000 litres per second, and never falling below 4,000 litres, has been utilized. For three-fourths of the year some 11,000 H. P. is available, and in winter about 6,000 H. P. The value of this fall is estimated at £12,000, the work of installation at £20,000, including gates, dams, tunnels (one of 600, one of 650 metres in length), two m. high and 2.5 m. wide, canal, two steel pipes 1.40 m. diameter, and 500 m. long. Adding the turbine cost, say, £440, gives a total of £36,400 for 11,000 H. P., or only £3.32 per H. P.

In comparison with steam-power, the author gives an estimate as follows for 100 H. P.:

Engine.....	£800
Boiler, &c.....	800
Building, &c.....	400

Total.....£2,000, or £20 per H. P.
(To be continued.)

TELEPHONIC.

TELEPHONE VS. RAILWAY.

The use of the long-distance telephone has diminished passenger travel on the railways. The extent of the loss suffered by the railways is not very well known and the importance of it is not admitted by all; but the newspapers have, now and then, given certain definite statements from well informed men, and there can be no question that the value of the telephone is increasingly appreciated. Another bit of significant evidence, reported to us on good authority, is the statement of a railway officer that the business of one of the limited trains between New York and Chicago has been practically ruined by the telephone. This comes from the chief executive officer of "one of the lines interested," and as there are only four or five roads interested in these trains, the reader can perhaps guess where the statement comes from.

This result is not very surprising. One of the definite objects had in view in putting on twenty-five-hour trains between New York and Chicago was the accommodation of brokers and business men of Chicago and the Northwest, who demanded quick time. Their trips to New York were taken on occasions of utmost importance, when a little time meant thousands of dollars. By means of the "Limited" the broker or business man was taken to New York in the quickest possible way. He talked as fast as he rode and made an equally quick return to Chicago. The business man was willing to pay the price assessed for this development in rapid transit.

The patronage of people whose time was less valuable to them was not expected to contribute much to the income of these trains, so that their whole dependence was expected to be, and was, on two classes: the business men aforesaid and pleasure travellers, to whom a few dollars extra was not a noticeable item.

Then came the introduction of the long-distance telephone. People at first were slow in realizing its benefits. Slowly but surely they have, however, come to appreciate its significance. A broker or a grain dealer in Chicago has in mind a "big deal;" he telegraphs to New York asking for certain information, and adds: "Call me

up by long-distance telephone and give me your answer." The result is that for fifteen or twenty dollars a talk is held with the New York man. Having received the telegram he has had an opportunity to concentrate his expressions to the shortest possible statements; he has even jotted them down and at the proper time calls up his man and transacts his business. So it is done every day.

The railway president quoted said that in the past he had found it necessary to spend about twenty days of each month on the road, leaving but ten days of his time at his office. But now, by aid of the long-distance telephone, he has reversed matters; but ten days are required on the road, giving him twenty days in the office. Half-a-dozen grain men, who had been in the habit of making frequent trips between Chicago and New York, said that for three or four dollars they could now transact business which formerly required a three-day trip.—"Railroad Gazette."

WATER POWER INSTALLATIONS.

ST. MAURICE POWER.

The Contract for Improving That River Has Been Awarded.

Messrs. Barry, Ross and McRae have received the contract for the improvements on the St. Maurice River, which the Shawenagan Water and Power Company has in view. The intention is to develop electrical power from the 169-foot fall in the St. Maurice, and the work, when complete, will probably cost well on to a million dollars. A part of the scheme is an electric railway from the falls to Three Rivers, a distance of about 19 miles.

It is expected that work will begin within a month, and that some four hundred men will be employed in the construction. Among those interested in the enterprise are Mr. A. F. Gault, Mr. J. N. Greenshields, Q. C., ex-Mayor R. Wilson Smith, Mayor Prefontaine, Mr. D. L. Lockerby and Mr. J. Joyce, a wealthy Boston gentleman. Mr. Gault is president of the company.

The promoters state that transmitting the current from the falls of the St. Maurice to Montreal, a distance of 80 miles, is not by any means beyond the lines of possibility.

CONDUCTORS.

TELEGRAPH IN AFRICA.

Mr. R. D. Mohun leaves Antwerp this week with an expedition to construct a line of telegraph from Lake Tanganyika to Stanley Falls on the upper Congo, under the commission of the Congo Free State. Mr. Mohun was formerly Consul at Zanzibar. It is not yet known what purpose this new line is to serve; but it may safely be surmised that it is but a link in some larger enterprise. Mr. W. H. Cavendish is already in Africa at the head of an expedition to carry the line northward. No doubt he will reach the point from which the Belgian line starts, so that in two years from now, if all goes well, the Cape will have telegraphic connections with Stanley Falls—that is, the Cape-to-Cairo line will stretch more than half the length of Africa. But the wire already runs from Cairo to the present quarters of the Anglo-Egyptian army on the Atbara. It will be at Khartum within a period which may almost be measured by weeks. If any force pushes on beyond Omdurman it will take the wire with it, and when the two years are completed the gap between the end of the line coming south from Cairo and the end of that running north from Cape Town will be much less than the distance from Khartum to Stanley Falls.—"St. James Budget."

RAPID CABLE LAYING.

The names of Lieut. W. C. Crutchley and C. Scott Snell, both Englishmen, are likely to become famous in military works if their plan of rapid cable laying proves to be all that it looks to be. The value of rapid cable laying in war can hardly be over-estimated, and it is a value which is more likely to increase than to decrease. In this new plan a cable is to be laid at the rate of twenty knots an hour, over a wheel on the ship's taffrail which is driven by a motor, and pays the cable out over the stern. Forward of this wheel is a wide drum, over which the cable passes on its way from the hold. In conjunction with the drum is maintained 2,000 feet of cable under constant tension.

The idea of a cable running out at twenty knots is rather startling, but experts are said to be of the opinion that this could be accomplished. The inventors have devised an apparatus for keeping it under control and completely stowing 2,000 cubic feet of cable. It is called the "Cable Accumulator," and is a small unit system of carrying the cable, which consists in placing the cable on board in drums of forty knots' capacity, and arranging them in columns, from which the cable is drawn off alternately; an automatic traveller to receive the cable as it leaves the drum and, finally, a controlling system, whereby an officer, located in a chart-room, keeps the attendant at the ejecting engine aware of the needed paying-out speed. The idea of the inventors is, that the officers on board a ship can induce currents in the cable without making actual metallic contacts with it. When the ship is right over the cable, messages can be sent along the wires, although there are no connections between the cable on the floor of the ocean and the instruments on deck. Recent experiments have shown that this can be done. There is no doubt whatever that the successful operation of such a rapid system would simplify some of the problems which now confront cable layers.—The Railroad Telegrapher.

ELECTRIC LIGHT AND POWER.

POSITIVE AND NEGATIVE ECONOMIES IN THE OPERATION OF SMALL ELECTRIC LIGHT PLANTS.*

It is generally considered quite sufficient to keep an account of expenditures and receipts, and to ascertain the amount of the balance at the end of certain periods, and if there is a balance, it is sufficient cause for jubilation.

Upon examination of a great many plants I feel sure that a great many of them, probably the majority, could reduce their operating expenses from 10 per cent. to 20 per cent. if—first—they were better informed as to the conditions under which they were operating, and—second—knew how to improve the conditions. It should also be noted that at the same time that reduction of expenses would be obtained, a better service would be given, with attendant better feeling on the part of the consumer, both public and private.

If we take up the consideration of the plant from the standpoint of a general superintendent, and desire to investigate its condition, we must first ascertain the useful results and the losses in each step, and then we can discuss changes either in the plant or in the handling of it, what such changes would cost, and the advantages resulting therefrom, and whether any or all shall be taken up.

We may start as follows:

- 1st. The production of power at the dynamo pulley.
- 2nd. The conversion of mechanical into electrical energy.

* A paper read by E. P. Roberts before the Ohio Electric Light Association.

3d. The delivery of the electric energy to the various points where it is to be converted into light, heat or power.

4th. Its conversion as above stated.

Taking the above in order, we have first to consider the production of the driving power. In this case we will work backward, that is, from the dynamo to the coal pile. If the plant is not direct-connected, we will have belts and probably shafts.

Belts and Pulleys.

Are the belts tighter than advisable? If so, it may be because they are oily and dirty; this means increased depreciation as well as increased power. Evidently they should be cleaned. Possibly the belt centres are too close together, and this distance cannot be increased. Possibly larger pulleys can be placed, preferably (if not making belt speed excessive) larger in diameter, but if this is not feasible, wider in face. Will this pay? Suppose a belt transmitting 100 horse power costs \$100, and is running too tight and adds 3 per cent. (3 horse power) to the friction more than it would do if running loose. Suppose to change to larger pulleys costs \$75 and the extra belt costs \$25 additional, making a total of \$100. Probably the life of the belt will be increased 50 per cent., say nine years, as against six. We then have for twelve hours' run for 365 days and 3 horse power a total of 13,140 horse power hours. If the additional coal is 4 pounds per horse power, and coal costs \$1.50, we will have a saving of \$39.42 annually, and a lessened depreciation of \$5.55, or a total of \$44.97. Not only a saving of 45 per cent. on the investment, but also less probability of breakage of belt, of poor lights, because of slips, of hot boxes and consequent cost of renewals, and less oil (though same is not figured), and, most important, less probability of shut-downs. The above is only a small item, but how many managers would spend \$100 to save a belt slipping? The station superintendent must get along with resin.

Possibly the only remedy applicable is a tightener, not a very desirable method, but generally 99 per cent. more objectionable, wasteful and noisy than necessary, because installed in the cheapest way possible.

Shafting.

In such a paper as this we cannot consider appliances in detail, so will pass on to the shaft. Here we find very little friction if the shaft is sufficiently stiff and in line, but if not, the friction may be from 15 per cent. to 20 per cent. of the rated load, and in many cases it is probably 10 per cent. more than necessary; therefore, for every horse power it transmits, it unnecessarily wastes in friction (if at the same rate as in previous example) \$13.16 annually in fuel, a considerable amount in oil, and increases the liability of hot boxes. The remedy may be a new and larger shaft, or new and better boxes, or the present shaft may only need alignment. The trouble and its amount must first be ascertained and then the remedy applied. Suppose that the shaft transmits 200 horse power and loses only 5 per cent. more in friction than it should, how much can we afford to spend to save that 5 per cent.? The direct saving would be \$131.30 annually, which would be 10 per cent. on \$1,313.00, and this is the amount we could not afford not to spend, and without considering the incidental advantages.

(To be continued.)

Newark, N. J.—Atwood Power & Speed Gage Co. has been incorporated by George F. Atwood, Harry A. Fields and George R. Swain; to manufacture electrical and steam measuring instruments, etc. Capital stock, \$75,000.

OPINIONS OF EXPERTS.

THE PRESENT STATUS OF ELECTRICAL ENGINEERING IN THE UNITED STATES.

By Dr. A. E. Kennelly.

By far the greater proportion of electric development has come within the past decade and a half. In a recent presidential address before the American Institute of Electrical engineers the writer pointed out, as illustrative of this, that in 1884 the words ammeter and voltmeter were just commencing to be generally recognized, and of electric traction there was none. At the present time the capitalization in electrical applications in the United States is estimated at \$1,900,000,000.

In 1884 a 50 kw.-dynamo was considered a large machine, while a 100-kw. Edison steam dynamo was justly called a "Jumbo." At the present time the largest size of generator built or building is of 4,600 kw. capacity. The price of dynamos in 1882 was about 20 cents per watt of output, while dynamos of similar running speed in comparatively small sizes, without switchboards, now cost about two cents per watt. The great reduction in price represents the aggregate result of the very large amount of labor devoted to this branch of engineering in the last fifteen years.

It is interesting to notice that the efficiencies of continuous-current dynamos have not made any marked nominal advance during the past fifteen years, though their output per unit of mass has considerably increased. Thus a 50-kw. dynamo tested at the Philadelphia Electrical Exhibition in 1884 is stated to have had an efficiency of approximately 92 per cent., and this would be considered a satisfactory performance in that size of machine today. But, whereas the output then was only six watts per pound of net weight, the output of a machine of similar rating and speed today would be about ten watts per pound. In other words, the efficiencies of the best dynamos of 1884 were already so good that it has not paid, at existing costs of power, to markedly improve them, and such improvements in material and design as have since been effected have enabled the manufacturers to increase the rating or yield, and, therefore, the cheapness of the machines. It seems probable, moreover, that this will continue to be the direction of future progress. We scarcely can desire more efficient machines than the best we have now, but we shall always desire cheaper and more powerful machines, and shall welcome any improvements which lead to them.

Another evidence of the development in dynamo machinery is its improved appearance. Formerly the only claim possessed by such apparatus was utility. More recently grace, the expression of unconscious power, has supervened, and the modern dynamo is often pleasing to look upon, as well as useful to operate.

The cost of generating a kilowatt-hour of electric energy from steam for electric lighting appears to have been at least 7.5 cents at the 'bus bars in 1884. At the present time the cost of delivering a kilowatt-hour to large street railway systems from steam is only about one cent, and the power house operating costs are reported in some cases as low as half a cent. In municipal electric lighting systems supplied at low pressure from steam central stations and hampered by relatively heavy distributing expenses, the retail price of the kilowatt-hour varies from 20 to about 4½ cents, according to the locality and quantity consumed. Niagara power is now sold to consumers in Buffalo at rates varying, according to the amount delivered, from two cents to slightly less than two-thirds of a cent per kilowatt-hour delivered.

The price of a 16-c. p. incandescent lamp sixteen years ago was about \$1. Now it is about 18 cents. The best lamps at that time, under laboratory conditions, gave about 0.28 mean horizontal normal British candle power

per watt, and under commercial conditions about 0.20. The highest pressure for which they could then be obtained was about 110 volts. At the present time lamps are obtainable giving normally 0.4 mean horizontal British candles per watt, while under commercial conditions the average lamp normally develops about 0.25 candle per watt. They can also be obtained (at 0.25 candle per watt) for pressures up to 240 volts, and are frequently installed on 220-volt mains.

Arc lamps were already so far advanced in 1884 that comparatively little improvement in their effectiveness has taken place, the gain having been made in economy of operation. Thus the carbons which cost at that time about six cents apiece now cost about two cents apiece. The enclosed arc lamp has of recent years become popular, owing to its diffused light and a carbon life of from 100 to 150 hours.

It has been estimated that about \$600,000,000 have been invested up to the present time in electric lighting stations and plants in the United States.

The best storage cells tested at the Philadelphia Exhibition of 1884 gave a yield, under laboratory conditions, of 3.4 watt-hours per pound of electrodes, with an energy efficiency of 69 per cent. when discharged at the mean current density of 12 amperes per square foot of negative plate surface; while the deterioration was comparatively rapid. At the present time storage cells are in use giving, under laboratory conditions, a yield of from five to six watt-hours per pound of charged cell, with an energy efficiency of about 85 per cent. when discharged at a current density of 4.8 amperes per square foot of negative plate surface. There are now storage batteries installed in the United States to the aggregate capacity of about 56,000 kilowatt-hours. The largest installation has 166 cells, weighs 500 short tons, and has an eight-hour discharge capacity of 22,400 ampere-hours, or 3,136 kilowatt-hours at 140 volts pressure.

A very great development has taken place in the direction of electric traction, by virtue of which the horse car, once so well-nigh ubiquitous in city streets, has almost entirely disappeared, while electric locomotives of 1,500 H. P. have even made their appearance on steam railroad tracks. The introduction of soft cast steel has been very advantageous to the electric motor, enabling its output to be increased from 5 watts per pound of net weight in 1864 to about 14 watts per pound in street car motors at the present time. It is estimated that there are today in the United States about 14,000 miles of electric railroad, with a nominal capital of about \$1,000,000,000, and employing about 170,000 men.

The electric transmission of the power of falling water is a branch of engineering that has come into service since 1884, and is making rapid strides, owing to the recent successful employment of high voltages and multiphase alternating currents. It has been estimated that about 150,000 kw. of this class of machinery is installed on the North American continent, commercially transmitting power to various distances up to 85 miles at various pressures up to 30,000 volts.

The alternating-current induction motor has become very popular in recent years, mainly owing to its powerful starting torque and its freedom from commutator and brushes. A burned-out armature, the perpetual source of dread in motor operations of days gone by, is practically unknown in this style of machine, even when put to severe service. Indeed, its depreciation under fair conditions appears to be as low as in any class of rotating machinery.

The alternating-current transformer has been correspondingly improved, developing, in large sizes, an efficiency of about 98.5 per cent., and an output, when cooled by external power, of about 100 watts per pound of weight.

(To be continued.)

THE AMERICAN ENCLOSED ARC LAMP.

We invite attention to the accompanying illustration of the American Enclosed Arc Lamp, which has been recently placed on the market by Mr. Chas. J. Bogue, 213-215 Centre street, New York.

Mr. Bogue has had long and varied practical experience in lamp construction work, and this latest produc-



The American Enclosed Arc Lamp.

tion of his long-burning enclosed arc lamp bids fair to rival in success his other numerous enterprises.

This lamp is very substantial in construction and specially designed to stand the roughest usage. The interior mechanism is simple and consists of but few parts, and there is nothing to get out of order. The question of trimming, always an important factor in enclosed arc lamps, has had special attention; the carbons can be placed in position without any trouble; the device for lowering the outer globe is simple and reliable.

The outer globe, it will be seen, is a perfect sphere, thus insuring an even diffusion of light without shadows. For outside service the finish is of japanned iron, and for inside use a variety of patterns are shown in fancy brass, polished or oxidized.

STRAY CURRENTS.

Electric power for sewing machines has formerly been applied from the motor to the spindle through gearing. The new German electric sewing machine has the power applied directly to the spindle. The spindle, which gives the reciprocating motion to the shuttle and needle, carries the armature of the motor. The field magnets are of soft iron, and the windings of the armature are in twelve sections. It is shunt wound, and there is a rheostat for regulating the speed, which can do so at any speed between 180 and 1,800 revolutions per minute.—Ex.

Mr. Lanz describes in "Wiedemann's Annalen" his researches upon the arc with aluminum electrodes. This arc is established under an E. M. F. of 19 volts. Between electrodes of aluminum and carbon the current passes more easily from aluminum to carbon, an effect contrary to that noticed in the electrolytic cell. This arc may be used, therefore, for the rectification of alternating currents, but the efficiency of such a rectification would not be higher than about six per cent.—Ex.

All who are interested in naval warfare will find the results of certain experiments, recently made with submarine search-lights on board an American vessel, worthy of some attention. The light streams through strong lenses from a point far below the water-line, and, taking a line almost horizontal, at last reaches the surface of the water, which it illuminates without betraying the position

of its own ship. These submarine search-lights are capable of being used at various depths and in various directions, so that they can throw a light upon the whole surroundings of ships lying at anchor.—Ex.

By means of a powerful Crooke's tube and a fluorescent screen, it is easy to determine the purity of a fuel. Carbon, in all its forms, is exceedingly transparent to the rays, while silica and silicates are opaque; and, on placing a lump of coal between the tube and the screen, all the intimate details of the slag and clinker forming portions of the fuel at once appear.—Ex.

Franz Clouth, of Köln-Nippes, prepares electric cables with lead armors, which, at first sight don't appear to offer any novelty. The conductors are surrounded by rubber or gutta-percha and between this and the lead sheaf is insulating material. This insulator, however, does not consist of cotton, or jute, etc., impregnated with some chemical, but is a homogeneous insulating mass. The cable end need not be especially protected for preventing moisture from creeping up the fibre.—Ex.

Carl Schmidt, of Düsseldorf, clothes the insulating tubes or pipes of electric conductors with asbestos.—Ex.

A large submarine cable for the Western Union Telegraph Company has just been completed at Trenton, N. J. It is to be used for the transmission of messages beneath the waters of Puget Sound, between Port Angeles and Victoria. It is 29 miles in length, and is divided into two sections. One section is 20 miles in length and the other nine. The entire cable weighs 188 tons, and it was made at the rate of one mile per day. The cable is a three-conductor one, gutta-percha insulated.—Ex.

ELECTRIC RAILWAYS.

ELECTRIC RAILWAYS IN CANADA.

Sault Ste. Marie, Ont.—A charter for a steam or electric railway from this city to Michipicoten has been applied for.

Peterboro, Ont.—The Peterboro & Ashburnham Street Railway has been sold to Arthur Stevenson. It is probable that some improvements will be made.

Yarmouth, N. S.—There is said to be a possibility of the Yarmouth electric railway being extended to Port Maitland next spring.

Hamilton, Ont.—The City Council has decided to extend the franchise of the Street Railway Company for twenty years. As soon as financial arrangements are completed, some improvements will be made in the system.

St. Catharines, Ont.—Haines Bros., of New York, who have secured control of the Niagara Central Railway, announce their intention of operating the road by electricity. Various changes in the road-bed will be made and the trestle work at Meritton and Thorold done away with.

Ottawa, Ont.—There is a movement on foot to secure the extension of the Ottawa Street Railway through Britannia, but it is probable that the matter will not be taken up before next spring. The cost of the extension is placed at \$125,000. It is also urged that the road should be extended to Rockland, a distance of 22 miles.

Hamilton, Ont.—Ratepayers in the district of Vine-land have asked the Hamilton, Grimsby and Beamsville directors to extend the road to St. Catharines.

Darmouth, N. S.—A scheme is on foot to construct an electric railway from Waverley to this place, thence to Musquodoboit Harbor. A meeting of the promoters will be held shortly.

Chatham, Ont.—An electric railway from Ridgetown to Rondeau Park, near this city, is one of the probabilities of the near future.

J. ALCIDE CHAUSSE.

ELECTRIC LIGHTING IN CANADA.

CANADIAN ELECTRICAL NEWS.

London, Ont.—Five tenders were received by the city for the supply of an incandescent lighting plant, but the figures have not been made public.

Thorold, Ont.—The town invites tenders for an incandescent lighting plant of from 1,500 to 2,000 lights. Particulars from R. J. Parke, consulting engineer, Toronto.

Barrie, Ont.—Recently the ratepayers sanctioned a by-law to raise \$35,000 for the installation of a municipal electric light plant. Tenders for the plant were taken some weeks ago.

Ottawa, Ont.—A company represented by T. Lindsay has applied to the City Council for permission to sell electric light and power within the city limits.

Pembroke, Ont.—The Council is obtaining information regarding the cost of installing a municipal lighting plant.

Campbellford, Ont.—The ratepayers have voted in favor of raising \$8,000 for the installation of a new incandescent lighting plant to replace the one now in use.

Carberry, Man.—A representative of an electrical company is endeavoring to obtain from the town a franchise for electric lighting for 25 years.

Dundas, Ont.—The town has given a franchise for electric lighting to a local company, of which H. Harper is manager.

Rossland, B. C.—There is an agitation in favor of municipal ownership of the electric light and waterworks systems.

Dundas, Ont.—The by-law granting a franchise to the Dundas Electric Co. was passed at the last Council meeting. The company agree to furnish power by December 1st next.

Peterborough, Ont.—The Peterborough Light and Power Company has requested the Council to grant exemption from taxation on proposed improvement. The company intend to build a new power house. If the request is granted the Dickson Co. will deepen their raceway. The proposition has also been submitted that instead of building the London street bridge over the raceway 20 feet wide the town will make it 52 feet wide, on condition that the Dickson Co. will build the centre pier.

Brantford, Ont.—The Paris Electric and Power Co., represented by Messrs. Carroll & Smith, has requested permission to distribute electric power in this city. The company intend utilizing the water power of the Grand River by constructing a dam.

J. ALCIDE CHAUSSE.

POSSIBLE INSTALLATIONS.

Florence, Ala.—The Florence Cotton Oil Co. will install an electric light plant at its mill.

Crescent City, Fla.—C. H. Cash and W. J. Pierpont have petitioned for electric lighting franchise.

Covington, Ky.—The Mayor may be addressed concerning construction of electric light plant.

Saratoga Springs, N. Y.—Albert L. Judson, of Albany, has applied to the Board of Street Commissioners for a franchise for an electric light and gas plant to be established in this city.

Orangeburg, S. C.—The Mayor may be addressed concerning construction of electric lighting plant.

Wharton, Tex.—G. C. Gifford contemplates the establishment of an electric light plant.

Utica, N. Y.—The plant of the Utica Electric Light Company will be enlarged.

Oakland, Md.—The Mayor may be addressed concerning the establishment of an electric light plant, for which bonds have been issued.

Kingwood, W. Va.—The City Clerk may be addressed concerning the establishment of an electric light plant.

Dalton, Ga.—The City Clerk may be addressed concerning the establishment of an electric light plant.

Lumberton, S. C.—The erection of an electric light plant in this city is being considered.

Laurel, Miss.—An electric light plant will be established here shortly.

STREET RAILWAY NEWS.

Jefferson City, Mo.—Sedalia Electric and Railway Co. has been incorporated by C. H. Reeve, J. C. Delong and others. Capital stock, \$400,000.

Niles, Mich.—The Indiana Electric Railroad, now building a line from Goshen to South Bend, Ind., will extend the line through Niles to Chicago.

Springfield, Ohio.—An electric line is to be constructed from here to Dayton, and the capital stock of the Dayton, Springfield & Urbana Railway Company is to be increased to \$1,000,000.

Sandusky, Ohio.—A syndicate of New York capitalists are reported to have a scheme on foot for the purchase of the Sandusky, Milan & Norwalk Electric Railway and the People's City Line.

Kansas City, Mo.—The Metropolitan City Railway Co. are making arrangements to change the power of its cable lines to the trolley system.

Knoxville, Tenn.—A survey for an electric road has been made between this city and Sevierville.

Cranford, N. J.—The Westfield & Elizabeth Railroad Company has been granted a franchise to build a trolley road through this town.

TELEPHONE CALLS.

Moundsville, W. Va.—Panhandle Telephone Co. has been incorporated, with a capital stock of \$50,000.

Grafton, Va.—The Grafton Telephone Co. has been incorporated, with a capital stock of \$10,000.

Bordentown City, Pa.—A new telephone company has been granted a franchise.

Amherst, Mass.—Amherst Telephone Co. has been incorporated, with a capital stock of \$4,000.

Thomasville, N. C.—The Thomasville Telephone Co. has been incorporated by F. S. Lambeth, J. W. Lambeth, C. A. Julian, J. F. Haden and others; to establish a telephone system in Thomasville and the surrounding country. Capital stock, \$6,000.

Fordsville, Ky.—Work will shortly be begun on the Fordsville-Hartford Telephone line.

Urbana, Ohio.—The Urbana Telephone Co. has been incorporated, with a capital stock of \$30,000.

Athens, Ala.—The lines of the Athens Telephone Company are being extended.

Bridgeport, Vt.—The lines of the Champlain Telephone Company are to be extended across the lake.

New Orleans, La.—A new telephone system will be established in this city by the People's Telephone Company.

Providence, Ky.—A telephone exchange will be established.

NEW INCORPORATIONS.

New York, N. Y.—The Nilsson Power Co. has been incorporated by F. E. Mygatt, P. A. Brown and S. F. Patterson; to manufacture machinery. Capital stock, \$5,000.

BUSINESS CHANCES.

Philadelphia, Pa.—The Southern Electric Light and Power Co. stockholders will hold meeting to consider the question of increasing the capital stock from \$400,000 to \$2,000,000.

Chicago, Ill.—E. D. Middlekauf, electrical goods, etc., gave chattel mortgage for \$2,000.

Lancaster, Pa.—Orne Electrical Construction Co. has made an assignment. Assets and liabilities, \$5,000 each.

Montevideo, Minn.—The Roller Mills and Electric Light Co. has been sold to the James Quirk Milling Co., of Waseca, for \$13,500.

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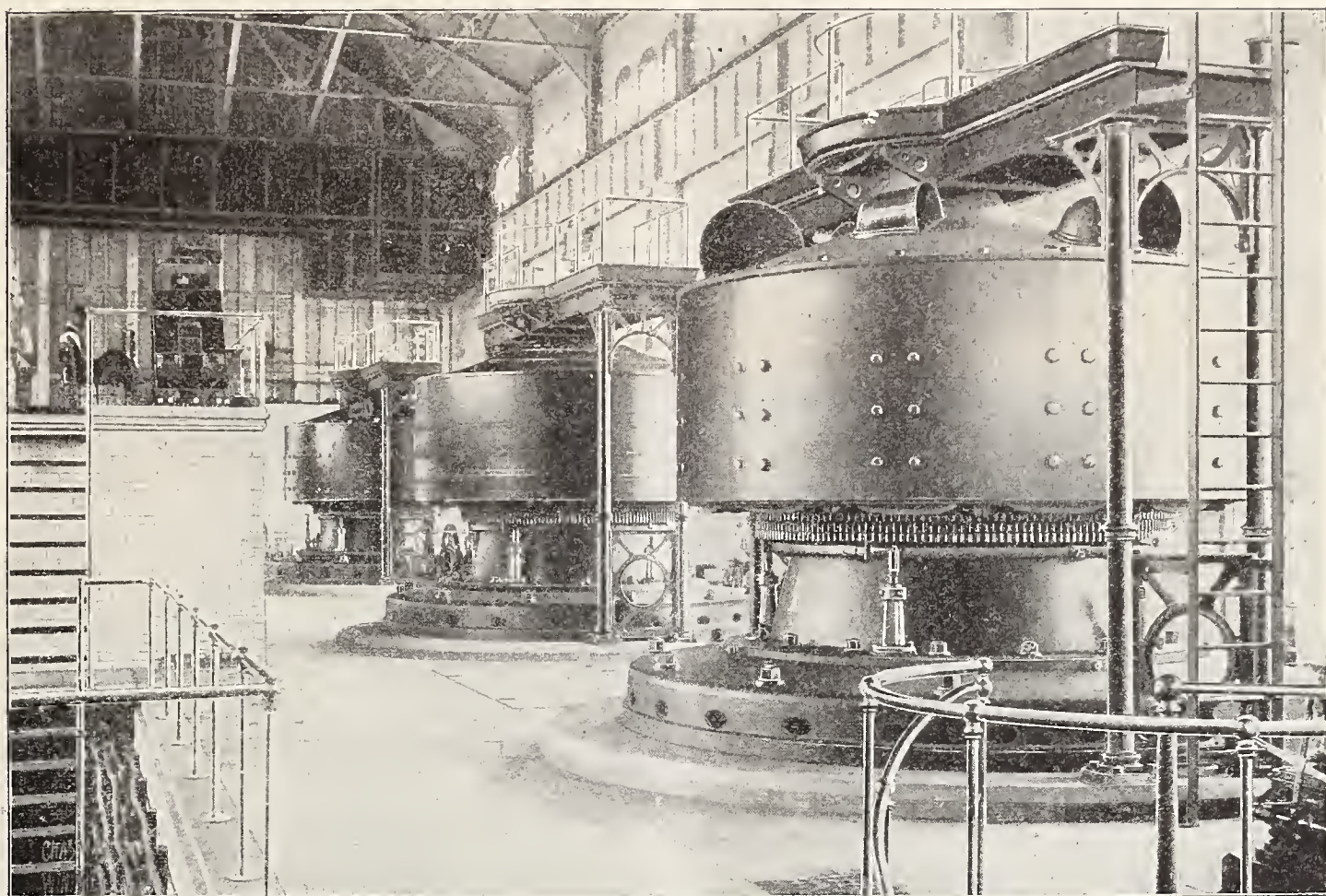


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TRANSMISSION OF ELECTRICAL ENERGY.



Interior View of Power House, Niagara Falls. Power Generated by Westinghouse Apparatus.

TWO HUNDRED AND FIFTY THOUSAND HORSE-POWER TRANSMITTED BY POLYPHASE ELECTRIC CURRENTS.

To transmit and transform electrical energy is one of the greatest feats of modern electrical engineering. The erection of a transmission plant has made demands upon the constructing electrical engineer which require a comprehensive grasp of the factors involved and the circumstances and conditions under which the power is to be transmitted. A transmission plant, pure and simple, involves three indispensable elements: the generator, the line and, at the receiving end, the motor. It makes no difference whether the electricity is transmitted as a continuous or alternating current; in either case the engineer must stand ready to select apparatus best suited in design, pressure and nature of the current for transmitting the power. The more perfect the generator line, and motor, the greater the efficiency of the system. But judging merely from the high qualities of these three elements the question still remains open as to which is the best system for transmitting electrical energy.

The sources of natural power at our command are coal, wind and water. Thus far but few transmission plants have been erected whose sole dependence upon power could be found in the coal heap, and fewer still relying upon the variable force of the wind. But the number of electric transmission plants whose source of power is water may be numbered in hundreds; the greatest in the world to be found at Niagara. It is quite natural for those desiring to invest in electric light or power transmission plants to inquire into the various electric systems in vogue.

Practice in this country has been entirely directed toward the adoption of the cheapest, most elastic, and most desirable system to be found. The inventions of Nikola Tesla have given such impetus to the use of poly-

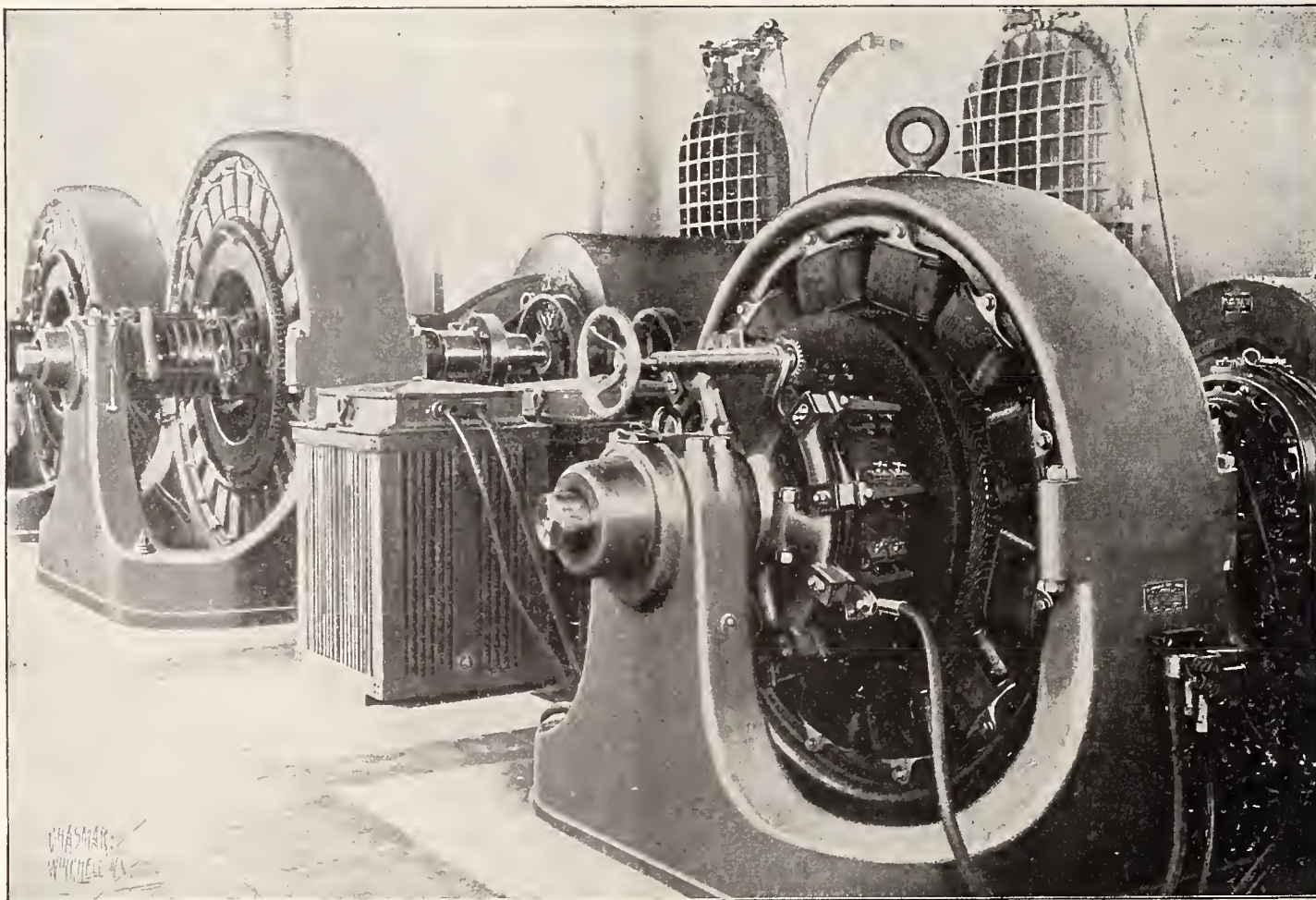
phase electric currents that today the largest transmission plants erected make use of polyphase currents and polyphase machinery. The advantages gained by the use of polyphase apparatus are such that simpler machinery is employed, less copper wire in the line, and a comparatively inexpensive receiving and distributing station. The fact that the pressure may be raised to thousands of volts and inexpensively transformed down to commercial pressures, makes a polyphase system of transmission superior to any other.

Dr. A. E. Kennelly, in an article entitled "The Present Status of Electrical Engineering in the United States," states as follows: "The principal engineering value of electricity today lies in its adaptation to the transmission of power through mills or cities, or from some locality where power is cheap to others where it is dear. A steel rope, by its bodily motion, can transmit with appreciable friction and depreciation some hundreds of kilowatts to a distance of from thousands of feet. A bare quiescent copper wire, one-half inch in diameter and supported on poles can, by maintaining an effective potential of ten thousand volts, by the motion of electric waves over its surface, transmit say twenty-five hundred kilowatts with an energy loss of two-thirds per cent. per mile and with practically no depreciation except that of the poles and support. The use of high pressures has thus become more frequent during the past few years. Alternating-current generators are now made to supply ten thousand volts at their terminals and insulation testing sets have been made for producing alternating pressures up to one hundred thousand volts effective. The electric transmission of the power of falling water is a branch of engineering that has come into service since

1884 and is making rapid strides owing to the recent successful employment of high voltages and multiphase alternating currents. It has been estimated that about one hundred and fifty thousand kilowatts of this class of machinery is installed on the North American continent, commercially transmitting power to various distances up to eighty-five miles at various pressures up to thirty thousand volts. The alternating-current induction motor has become very popular in recent years mainly owing to its powerful starting torque and its freedom from commutator and brushes. A burned-out armature, the perpetual source of dread in motor operations of days gone by, is practically unknown in this type of machine, even when put to severe service. Indeed, its depreciation under fair conditions appears to be as low as in any class of rotating machinery. The alternating-current transformer has been correspondingly improved, develop-

Aggregate horse-power of generators.....	219,649
Aggregate horse-power of motors and rotary transformers.....	35,511
Aggregate horse-power of static transformers....	51,598
Total horse-power....	306,758

The Westinghouse Electric and Manufacturing Company have sent polyphase machinery to every state in the Union; also, Brazil, Canada, Central America, England, Hawaiian Islands, Ireland, Jamaica and Mexico. In this Mexican plant at Tlalnepantla, bought by G. & O. Braniff & Co., a pressure of twenty-two thousand volts is used for transmission, the capacity of the plant equaling six thousand horse-power. The static transformers they employ, self-cooling and oil-insulated, have an aggregate capacity of seven thousand two hundred horse power.



Interior View of Power House at Dolgeville, New York.

ing in large sizes and efficiency of about 98½ per cent., and an output when cooled by external power of about one hundred watts per pound of weight."

The electrical power transmitted from Niagara Falls is generated by Westinghouse apparatus. The system in use is the polyphase; current is transmitted as far as Buffalo, where it is received in transformers and subsequently operates Tesla motors. About forty thousand horse-power used in this locality is consumed for industrial and manufacturing purposes on the American side. One thousand horse-power will soon be utilized when the transmission plant is complete on the Canadian side.

In the illustrations the Niagara Falls plant is shown—a scene familiar to most of our readers. Other illustrations show the machinery built by the Westinghouse Electric and Manufacturing Company of Pittsburg, Pa., for electric power concerns. The three-phase transmission system has been generally adopted by such concerns as the Helena Water and Electric Power Company of Helena, Montana; The Canadian Niagara Power Company of Niagara; The Apple River Power Company of New Richmond; The Niagara Electric Light and Power Company and many others. In total the list of polyphase-current transmission plants and equipments amounts to the following:

Lord Kelvin, formerly Sir William Thomson, one of the layers of the first Atlantic Cable, with Cyrus Field, while on a visit to this country in September, 1897, stated, "I believe that with proper apparatus electric current can be carried as far as three hundred miles from the place of its generation and be used with commercial success." This statement was made after he had seen the great five thousand horse-power Westinghouse generators at Niagara.

To transmit power from Niagara Falls to New York is an immediate and practical possibility. If it were not for the æsthetic taste of Americans the power of the great Falls could be used to run the machinery of Buffalo, Rochester, Syracuse, Albany and New York and illuminate their streets at night. The transportation of coal from the Pennsylvania fields to this city would be reduced to a minimum by the erection of a gigantic plant at the coal mines and the economical transmission of electrical energy from that point to Greater New York. Electric power would then be within the means of the poor as well as the rich to light and heat their homes and be the animating force operating the wheels of all industries.

Winchester, Va.—The Winchester Gas Co. contemplates installing an incandescent electric lighting plant.

A FRENCH VIEW OF ELECTRICAL POWER TRANSMISSION.

(Continued.)

The price of the engine seems high; the present writer would be glad to sell first-class steam engine power at little over half the above figure.

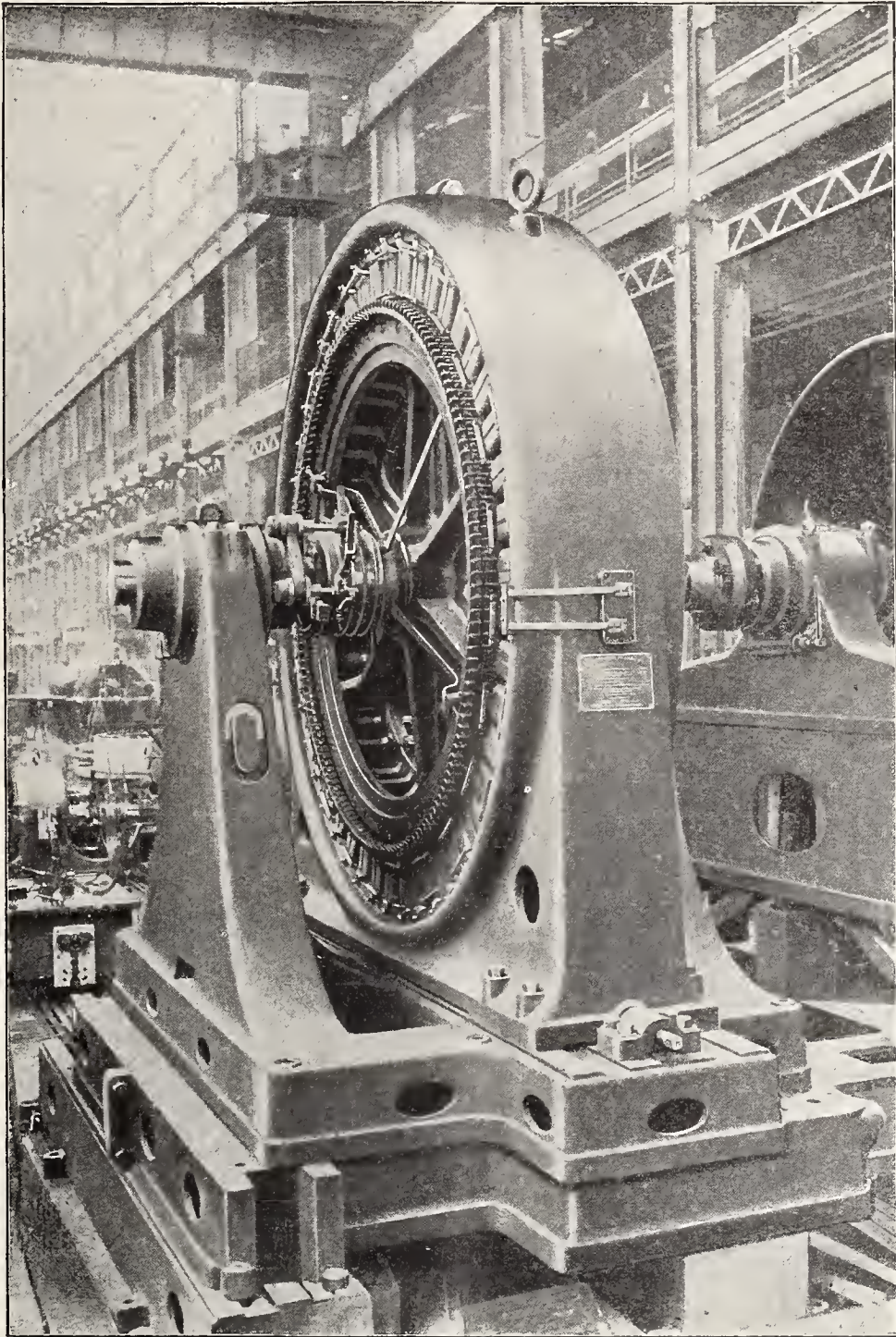
For a 300 H. P. engine the cost is thus set down:

Engine	£2,000
Boiler, etc.....	2,000
Buildings, etc...	800
Total.....	£4,800, or £16 per H. P.

while, for short working hours, steam may sometimes be better placed. The figures seem to us to indicate that the French are better hydraulic than steam engineers, and able to do more with a given sum than when they set out to instal steam plant. To pay £6,000 for boilers to give 1,000 H. P. in economical engines seems to us very high pricing.

Taking the case of 140 H. P. at the point of application, a hypothetical case is supposed at 4,000 volts, the water power being of the high-fall type, and the utilization day and night for 8,760 hours. The cost will then be:
For electric installation..... £1,791
Hydraulic plant, 200 H. P. at 170 francs..... 1,360

Total..... £3,151



650 Kilowatt, Two-phase Westinghouse Generator. Built for the Helena Water and Electric Power Co., Helena, Montana.

while a third estimate for 1,000 H. P. is:

Engine.....	£4,000
Boiler, etc.....	6,000
Buildings.....	2,000
Total.....	£12,000, or £12 per H. P.

Even at half the foregoing estimates the cost of steam plant appears higher than the cost of high fall water power, in addition to which there is also to be added the continual expense in fuel, wages, etc., and if the power is used for many hours, water power has the advantage,

Interest, etc., at 10 per cent	315
This is the annual cost. The same power from steam is given as follows:	
140 H. P. at £20.....	£2,800
Interest at 10 per cent.....	£280
Total H. P. hours.....	1,226,400
Tons of coal burned.....	1,230
Cost at 30 francs per ton.....	£1,476
Total annual cost.....	£1,756

The coal is dear at 30 francs (24s.), and this item might be reduced anywhere down to a fifth, and the total cost would then be about £580, but even this is far above the cost of water power,

Taking the voltage at 1,000 and a low fall and a utilization of 3,000 hours annually, the annual charge of 10 per cent. on the installation for the same power at the rate of £30 per H. P. will come out as £1,273, while the cost of the steam power will be as before, £280, for interest, and only £504 for coal, or £784 annually. Even with such dear fuel, the steam now comes very much cheaper than water power. It is thus important to seek high falls, high tensions, dear coal, and long hours in a proposed water power with electrical transmission, while the reverse data favor the application of steam power.

The figures presented by M. Janet are by no means favorably chosen for steam power. It is obvious, therefore, that coal-using countries are not likely to be so easily run off the road as loose thinkers are so apt to make out.

In discussing the system of transmission to be employed, there is but one alternative; direct or alternating currents alone are available; the first-named have the advantage of age, having been those of the Gramme machine. A dynamo may be constructed for all speeds, tensions, intensities, and other properties, so long as these are properly balanced; but for continuous-current machines there remains the difficulty of insulation at high tensions. This difficulty comes in at the commutator. This becomes so multiple in its bars at high tension that difficulties arise in construction. Without going into details, it may be said that currents of 3,000 to 4,000 volts work all right, and they may be coupled so as to add to this tension, and partisans of continuous current are still numerous, despite the brilliant success of alternating current, and would not hesitate at continuous transmission even at 20,000 volts. But the author believes that the current of today is the alternating. Simpler machines produce it; the commutator is absent. Transformers are applicable for raising the tension to any desired amount—apparatus without a moving part.

With all advantages, however, the alternating current has also its disadvantages. While the motors are also simplified, they present difficulties in starting not yet surmounted. Though very well for regular work at full power with few stoppages, the alternating current must still give way to direct current for opposite conditions. This difficulty, however, appears likely to be swept away by the discovery of the polyphase alternating machines. Equally available for high tension, they have the general advantages of continuous currents, and in respect of starting of motors are but little in arrear of the latter. They have the further advantage of diminishing the weight of line necessary. Without going into detail, it may be said that tri-phase machines have three terminals in place of the two we are accustomed to find in all electrical appliances—three lines in place of two.

Thus, if E be the tension between any two terminals, I the current in the line, it can be shown that the power carried under these conditions is $P = EI\sqrt{3}$. If R is the resistance of one line, the power lost in the line is $3RI^2$. With two-line transmission to carry the same power at equal tension, $P = EI'$ where $I' = I\sqrt{3}$. Let R' be the resistance of one of the two lines, then the power lost will be $2R'I'^2 = 6R'I^2$. If we desire the loss in each case to be the same, then must $3RI^2 = 6R'I^2$, whence $R = 2R'$, from which it directly follows that with tri phase current the cross-section of each line will be of half the area needed for ordinary current. If p is the weight of one line of tri-phase the total weight of line for tri-phase current is $3p$, and for ordinary current $4p$, thus securing an economy of 25 per cent.

All this demands that the introduction of polyphase current should be considered as one of the greatest steps in modern electrical industry—and, in fact, most large installations are based on polyphase working. Yet contin-

uous current will never lose its advantages, and will always be used for certain special cases, but it seems that simple alternating current ought to be excluded from new installations. This has been a little forgotten of late.

The author concludes that the exhibition of 1900 will afford a chance of studying all systems on a grand scale. We should add that the author of the interesting article we have abstracted as above is M. Paul Janet, of l'Ecole Supérieure d'Electricité.

The above interesting and exceedingly instructive article was translated by a contemporary, the London "Electrical Review," from the French. By the use of polyphase currents, the advantages gained in a commercial and financial sense are very great. Both practice and theory bear out this idea. M. Deprez was among the first to attempt electrical transmission of energy; his countryman, M. Paul Janet, is a worthy disciple.



WILLIAM ROCHE of 259 Greenwich street, N. Y., has just placed on the market a new No. 4 vest-pocket battery that will light a small incandescent lamp. For novelties, scarf-pins, etc., it will give on closed circuit 1.6-10 volts and nearly 11 amperes. One of these cells measures 3 1-2 inches high, 1 5-8 inches in breadth, and 1 1-16 inches in width, oval shape.

These combination vest-pocket batteries are very valuable and have been adopted in laboratories for testing, etc. Mr. Roche's 7-inch x 3-inch cell has been adopted by physicians for cautery work, and he can refer to a number of physicians using this cell who will testify to its being the only dry cell used for practical cautery work.

The demand for Mr. Roche's No. 1 and 2 dry cells is increasing to such a great extent that he intends taking an entire building to make up stock, so as to keep pace with the large demand for his goods, as every mail brings in new orders.

The fact that the United States Navy adopted the new Standard dry batteries for every need in their department is sufficient guarantee as to their quality.

We desire to call particular attention to Mr. Roche's new 7-inch x 3-inch cell for gas engine, slot or automatic machine work.

STRAY CURRENTS.

An exchange notes that the Canadian Pacific Railway Company has one through wire on its telegraph line from Montreal to Vancouver entirely of copper. The length of this wire is 2,897 miles.

Professor Zickler, of Brunn, has invented a system of wave telegraphy which depends upon the fact that if the ultra-violet rays of the spectrum are directed upon a spark-gap, the latter may be wider than it otherwise could be and yet allow the spark to pass.—Ex.

Regarding the amount of electrolytic action of brass pipe in comparison with other materials, such as iron, copper or lead, there appear to be no positive data. A study of the chemical equivalents of the various metals used in underground construction will, however, indicate that common brass pipe, containing about 70 per cent. of copper and 30 per cent. of zinc, would suffer from electrolysis somewhat more than iron pipe and not so much as lead. Approximately, a current of one ampere flowing steadily from an iron plate of ample proportions will remove about 20 pounds of iron per year. Under the same conditions 75 pounds of lead could be removed, and brass would suffer a loss somewhere between these figures.—Ex.

M. H. Le Chatelier has presented to the Académie des Sciences a series of valuable observations on the effect of temper and constitution upon the electrical conductivity

(Continued on page 232.)

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A PHYSICAL LABORATORY FOR THE PEOPLE.

We have commented in previous issues of "The Electrical Age" upon the great advantages resulting from the founding of a national physical laboratory. It seems that in England they have seriously considered the advantages of such an institution, and a committee composed of Lord Raleigh, Sir Courtenay Boyle, Sir Andrew Noble, Sir John Wolfe-Barry and Messrs. A. W. Riecker, W. C. Roberts-Austen, Alexander Siemens, T. E. Thorpe and Robert Chalmers has been appointed to consider the proposition from two standpoints. We are content with considering these standpoints and the conclusions arrived at by the committee.

As this matter has become, in a sense, of immediate national consequence under direct government control, it will certainly be interesting to Americans to read the following:

"The desirability of establishing a laboratory for the verification of instruments, testing materials, and maintaining standards is the first question. The second is in relation to the desirability of associating this laboratory with any public institution." The replies turned in, according to our esteemed contemporary, "The London Electrical Review," are as follows: First. That a public institution should be founded for standardizing and verifying instruments, for testing materials and for the determination of physical constants.

Second. That the institution should be established by extending the Kew Observatory, and that the scheme should include the improvement of the existing buildings and the erection of others in its neighborhood.

Third. That the Royal Society should be invited to control the proposed institution and to nominate a governing body on which commercial interests should be represented; the choice of the members of such body not being confined to fellows of the society.

Fourth. That the permanent secretary of the Board of Trade should be an ex-officio member of the governing body; and that such body should be consulted by the standard office and the electrical standardizing department of the Board of Trade upon difficult questions that may arise from time to time or as to proposed modifications and developments.

Whereas the tone of this entire series of conclusions is peculiarly English, it is as English thoroughly business-like, on account of the fact that the Royal Society exercises direct control over this institution. There is another feature of supreme importance to ourselves in this circumstance, and from it springs a lesson that will day by day become more apparent, that the knitting together of the interests of the nation and our savants is productive of the highest good and greatest benefit to the general public. The field of scientific development has grown and is growing to such enormous proportions that this coalition is natural and in perfect harmony with our ideas of progress. Applied science has added so much to the wealth and prosperity of the United States that the establishment on our part of a great national laboratory would give great impetus to fields of work still inchoate and new life to the efforts of worthy and practical inventors.

ELECTRICIANS MEET FOR SOCIAL PURPOSES.

The representatives of leading electrical industries of the Eastern States met Tuesday evening, October 25th, with their wives and friends at Wallack's Theatre, where seats had been secured in advance for the "Fortune Teller." It is the idea of certain active spirits that the formation of a new association, attendance to which will mean pleasure for the ladies as well as the gentlemen, will meet with great success among the representatives of our Eastern concerns. By bringing together families and friends in the trade, certain great benefits are derived which offer a solution to some of our most serious commercial problems.

In consequence of invitations sent out to those connected with the electrical industry, a very large number accepted, and nearly a hundred gentlemen, with their wives and fair friends, spent part of the evening listening to the Alice Neilson Opera Company. The guests were received by a committee composed of H. B. Kirkland, John Dale, Frank Harrington, E. S. Keefer and H. Baker, respectively of the following concerns: the American Circular Loom Company, Dale Manufacturing Company, India Rubber & Gutta Percha Insulating Company, Western Electric Company and the Elektron Manufacturing Company.

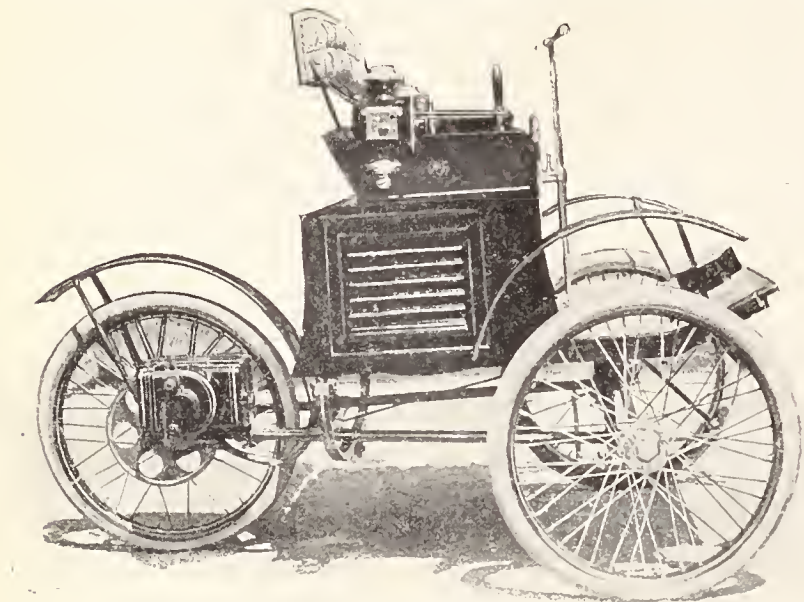
During the opera Mr. Dale presented a startling and beautiful bouquet of roses to Miss Neilson. Just before she accepted the bouquet Mr. Dale touched a button which caused it to throw out a blaze of electric light. The bouquet had been made up with ingeniously hidden batteries operating a number of miniature lamps. Miss Neilson was greatly amazed when the light was thrown on. The applause was deafening. She was encored three times and finally came before the curtain, an unusual proceeding on her part.

After the opera the party took electric cabs to the Astoria, where a fine collation awaited them. Each of the members of the committee attended to one of the five tables and introduced the guests to each other. Each lady received a beautiful bouquet of chrysanthemums, roses and other flowers, and the gentlemen a boutonniere. The menu cards were a great novelty, and were all kept in remembrance of the occasion.

of steel. The most important experiments were directed to ascertain the influence of the temperature of tempering upon the conductivity, samples of steel containing 0.84 and 1.13 per cent. of carbon being chosen. The subjoined table shows the ratio of the resistance after tempering to that before tempering, the temperatures being given in the top line:

Temperatures..... (Centigrade).....	Degrees—————					
	710	740	810	850	950	1,000
0.80 per cent. carbon.....	1	1.3	2.1	2.2		2.2
1.13 per cent. carbon.....	1	1.3	1.6	2.1	3	

These results go to show that tempering does not modify the resistance if performed at temperatures below the point of recalescence (710 degrees C.), the same condition holding good for the change in mechanical properties. The resistance then increases with the temperature of tempering up to a maximum depending upon the carbon content of the steel, the higher carbon steels going



Riker Electric Tricycle.

up to higher resistances. The presence of chromium in the steel causes the increase of resistance to become more marked, while tungsten seems to exert a contrary influence.—Ex.

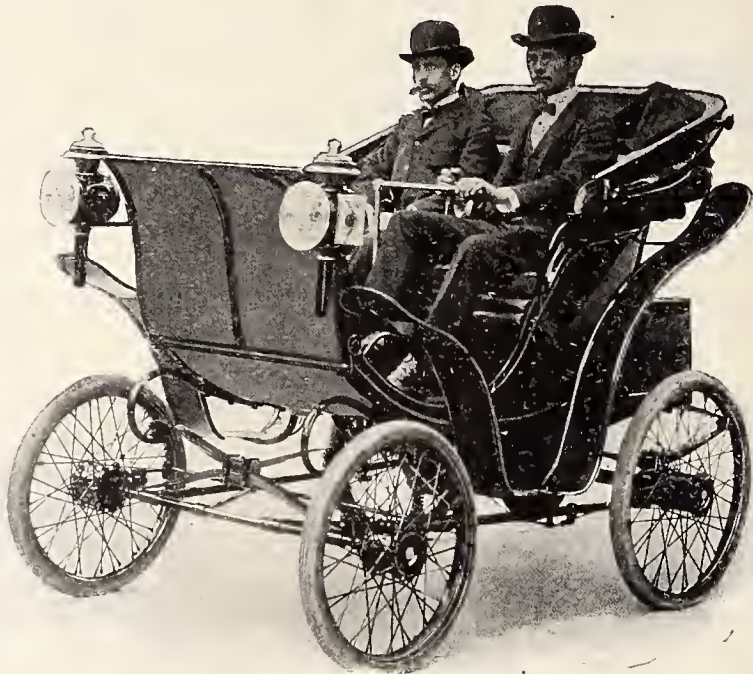
ELECTRIC AUTOMOBILES.

ELECTRIC MOTOR VEHICLES.

The illustrations accompanying this sketch show a variety of electric motor vehicles, the use of which will, in the course of time, become so general that Greater New York, Paris and London, as well as other large European cities, will present the same appearance in regard to the method of street locomotion in vogue. The ideal vehicle is acknowledged to be one driven by electricity. For summer service there is nothing that can bear any comparison with the electric auto-mobile, and in winter during evening the well-lighted interior of these carriages, noiseless advance, cleanliness and freedom from motion speak for themselves. The steady increase in the number in use proves to the casual observer that the electric vehicle is fast becoming a feature of city life as familiar to him as electric cars and other modern conveniences.

The Riker Electric Motor Company manufacture an electric tricycle with tires two and one-half by twenty-eight inches in diameter. Its weight without load is eight hundred pounds and its carrying capacity four hundred and fifty pounds. The tricycle is run by a three-quarter K. W. motor, governed by a controller giving three speeds ahead and two behind. This tricycle can cover twenty miles per charge of battery on level roads.

Its maximum speed is twelve miles an hour. It is supplied with a combination voltmeter and ammeter, electric side lights, and is driven from the rear and steered from the front wheels.



Riker Electric Victoria.

The Riker victoria has tires three by thirty-two inches in the front and thirty-six inches in diameter at the rear. Its weight is eighteen hundred pounds, seating capacity two people, and is operated by a one and one-half K. W. motor, governed by a controller giving three speeds forward and two speeds backward. The total mileage per charge of batteries on level asphalt and macadam reaches twenty-five, the maximum speed practicable twelve miles an hour. In other respects the general construction of the Riker electric auto-mobiles is similar, the phaeton holding two passengers, weighing eighteen hundred and eighty pounds, and being driven by a one and one-half K. W. motor; the two-passenger trap weighing sixteen hundred pounds, same horse power of motor; the four-passenger trap weighing twenty-five hundred pounds and being driven by a two K. W. motor.

Mr. Riker's delivery wagon, one of the most beautiful constructed, made for the firm of B. Altman & Company,



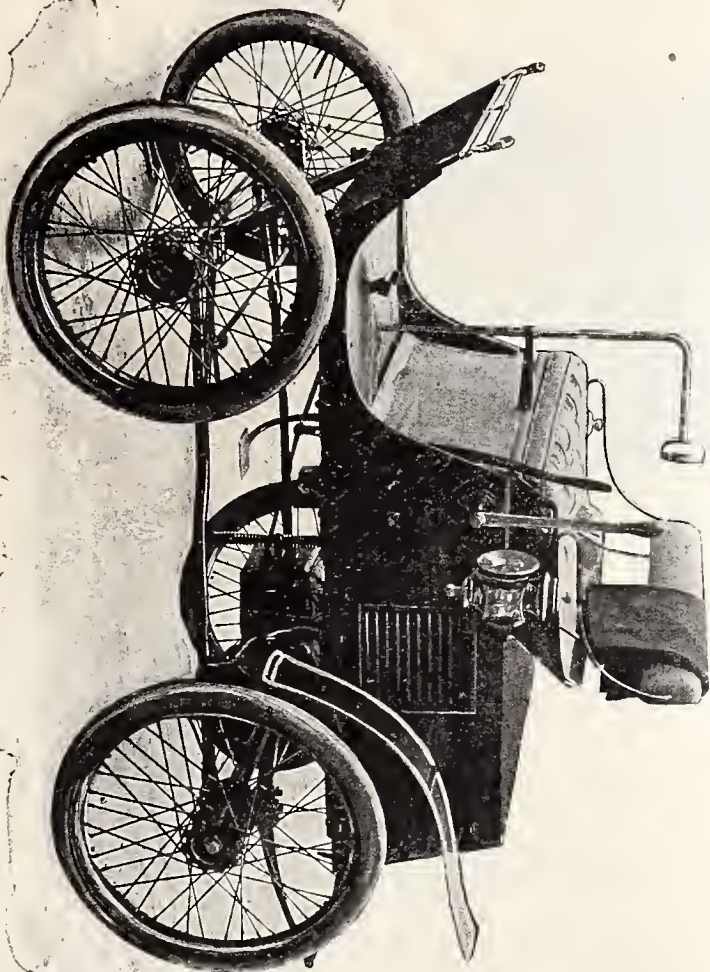
Riker Electric Phaeton.

weighs twenty-nine hundred pounds. It has a carrying capacity of eight hundred pounds, in addition to the operator and delivery man, and is driven by a three K. W. motor. Its maximum speed is nine miles an hour, and it can cover twenty miles on level roads for each charge of battery.

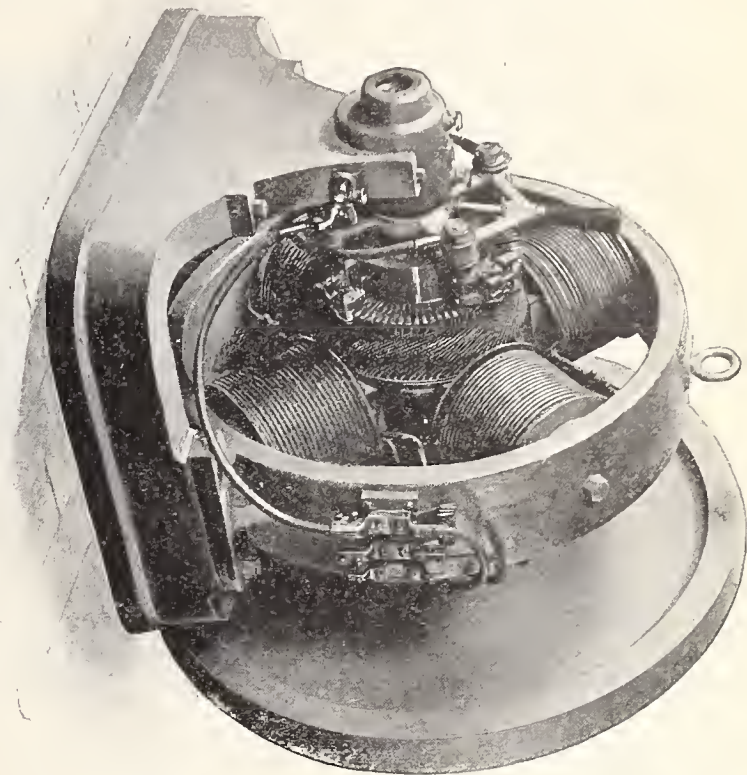
With the exception of the electric tricycle the carriages above described can cover a run of twenty-five miles without recharging, including the four passenger trap.

ure in showing our readers the Riker electric vehicle motor, with cover removed, showing commutator. They are made in sizes running as follows: three-quarters, one

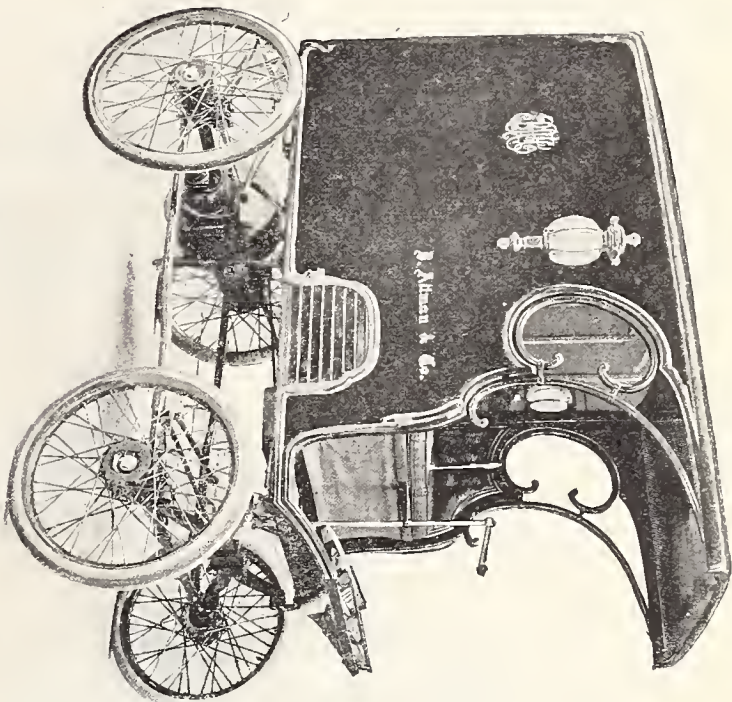
Riker Electric Two Passenger Trap.



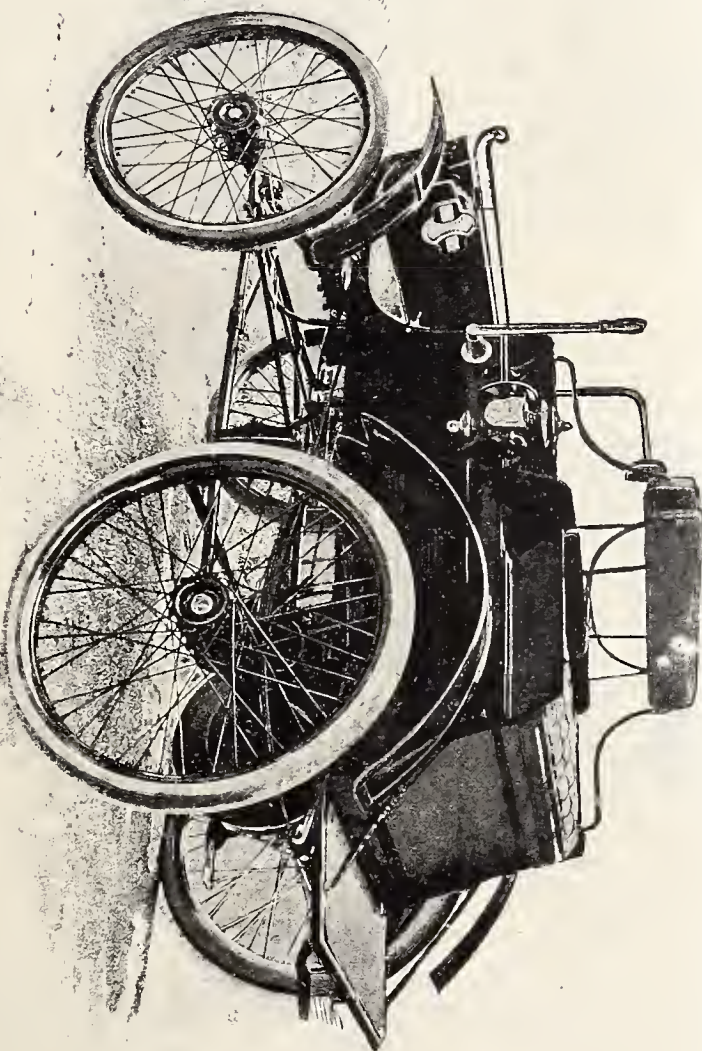
Riker Fly Wheel Dynamo for Bel Connection to Gas Engine.



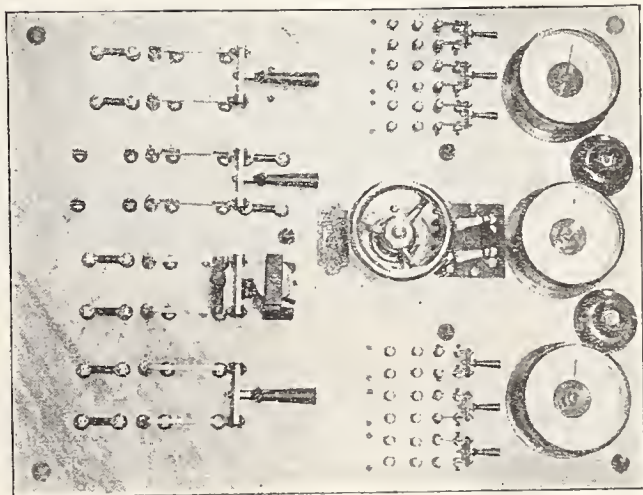
Riker Electric Delivery Wagon.



Riker Electric Four Passenger Trap.



Switch Board.



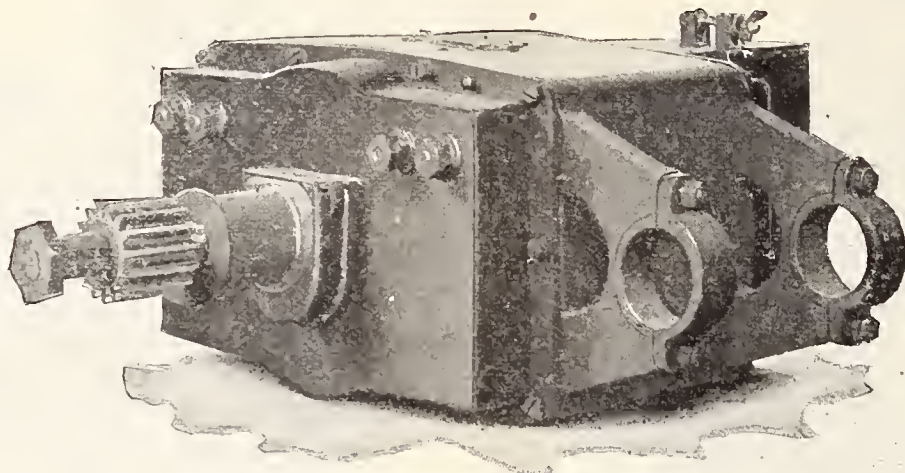
This delivery wagon is supplied with a combination volt and ammeter, electric side lights, driving from rear wheels and steering from front wheels as those previously described. In addition to these illustrations we take pleas-

and one-half, two and three k.w.; the larger sizes take eighty volts, the three-quarter k.w., forty volts. The weights respectively are, eighty, one hundred and sixty, one hundred and seventy-five and two hundred and

eighty-five pounds. An interesting addition to the apparatus required for electric motor vehicles is the Riker fly-wheel dynamo for belt connection to gas engines. It is not subject to fluctuations in speed of the engine and gives the greatest satisfaction in charging the storage cells. The switchboard, supplied with a complete charg-

to dilate upon the subject of electricity. His neighbor had just sat down amid the shouts and applause of his colleagues.

"Mr. Crinkle," came the voice of the toastmaster, and in the way of an introduction presented him by saying:



Riker Electric Vehicle Motor.

ing plant, is also represented. For compactness, high efficiency, durability and convenience, the fly-wheel generator, switchboard for charging one or more vehicles at the same time and electric carriage apparatus cannot be excelled.

The factory and offices of the Riker Electric Motor Company are at 45-47 York street, Brooklyn, N. Y.

Under the heading of Opinions of Experts, Mr. Kennelly's article will be continued next issue.

AMONG OUR ELECTRICAL FREINDS.

AN ORIGINAL DEMONSTRATION OF THE FUNDAMENTAL PRINCIPLES OF THE DYNAMO, THE TELEGRAPH, AND THE TELEPHONE.

By C. J. Miller.

'Twas Willie Crinkle's first opportunity, and he embraced it bravely. Just a year out of college, but it

"Now we'll have some electricity. To be brief, here is a topic none of you have touched upon, perhaps out of respect to Mr. Crinkle's presence. We, no doubt, have the treat of the evening in store for us, probably in the shape of a thunderbolt from our friend Crinkle. As Vulcan, we will listen to him with all the reverence required by so mighty a deity."

Mr. Crinkle, arising in a half-hearted manner, very much embarrassed at first, soon became eloquent. He said:

"Gentlemen, since electricity is the subject with which I am most familiar, I feel it my duty, as everyone else has contributed to my entertainment, that I should at least try to do the same in return. I, however, promise you no entertainment unless it be a charitable interpretation of my efforts by yourselves. To begin with, I have thought out a simple plan of illustrating, in a few words, the principle of the telegraph, the telephone and the dynamo. Under these very peculiar circumstances, I shall have to employ all of you to help me a little in illustrating what I have in mind.

"In the first place, since there can be no flow of electricity without a closed circuit, I will ask you all to join



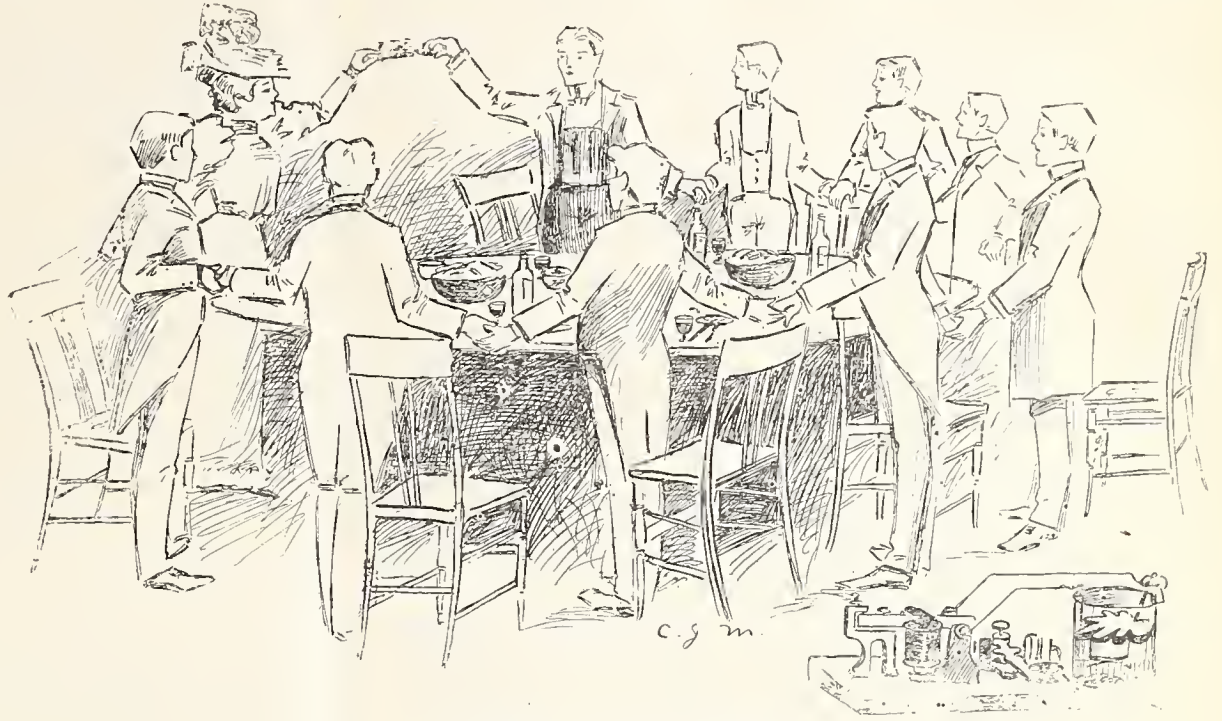
Opening Remarks of the Demonstrator.

shows the genius of the lad. While almost everyone else around the festive board had had his little say upon some topic or other in the technical field of applied science, Willie was still to be heard from. Electricity had been his study, and he had not yet spoken. It was soon to be his turn, and he was quietly fathoming every nook and corner of his inexperienced young mind, aware that as soon as the present speaker finished he would be called upon

hands. This chain has passing through it a current of good will, and represents the circuit usually employed to act as a conductor of electricity; my right hand to represent the positive pole and my fair neighbor's the negative. The good food and wine I have partaken of we will suppose to represent the chemical constituents of a rather strong cell. The current will flow from my right hand around through your bodies to my left.

"To illustrate the telegraph, which is merely a combination of an electric circuit, battery, key and sounder, I will proceed as follows; this little pocket outfit I possess

the other hand," said Mr. Crinkle, smiling upon his auditors, "a display of weakness on my part can be quickly remedied by the addition of a small bottle of exciting



Principle of the Telegraph.



Elucidation of the Principle of the Carbon Transmitter.



Rotation in a Magnetic Field.

serving me in many cases when I have an odd hour to practice with. Should I, as battery, be too strong it will be easy for my neighbors to offer resistance to me. On

fluid. If you will notice, the movement of the key would, in the light of my remarks, open and close the circuit and operate the sounder, exactly as it is performed in actual

practice. By exercising your imaginations in my behalf you will now comprehend the action of the carbon button transmitter; my fair neighbor's palm the diaphragm, my finger the carbon block, through the variability of whose touch are transmitted sound waves, transformed by this mechanism into unequal flows of current.

"It is hard, at first, to understand how a dynamo generates electricity, but if we bear in mind Faraday's great discovery, that a closed coil revolving in a magnetic field will develop a current of electricity, it will be easy to understand my ocular demonstration. Let each alternate man around the table take both hands of his neighbor, so as to form a succession of separate loops. These are the independent coils of an armature, or a motor, if you will have it so. By closing the circuit and providing a magnetic field, the coils are set in rotation, or conversely, if rotated before myself and partner, will produce a series of electric currents. In other words, the fundamental principle of the dynamo is illustrated by pairs of you clasping hands and moving quickly in continued rotation around the festive board.

"I hope that if the instruction you have derived from my extemporaneous remarks has not been wholly satisfactory, you will at least have been entertained and interested sufficiently to allow me to resign my position in favor of our worthy toastmaster."

ELECTRIC LIGHT AND POWER.

POSITIVE AND NEGATIVE ECONOMIES IN THE OPERATION OF SMALL ELECTRIC LIGHT PLANTS.*

(Continued.)

A bicyclist knows the advantage of a light running, well lubricated wheel, but often that same bicyclist will vote against spending money to save power in an engine. It is sometimes said that a woman's idea of a horse power is only limited by the number of people who can get into the vehicle. There have been, in the past, men who held similar ideas as to the horse power of an engine—"as long as the horse can do it, all right"—the same as to the engine.

The Engine.

We now come to the engine: In large stations it is customary to so operate that whenever an engine is in use, it is at or near its rated load or point of maximum economy of operation. Most engineers know that to run an engine on a light load is wasteful, but many do not realize that it is one of the greatest of extravagances. The losses in an engine are very nearly constant, and therefore for light loads become a very large percentage of the total. Suppose we have a 200 horse power engine in use eight hours nightly, on a load which a 75 horse power engine would run at a rated load. If the engines were of the same type there would be practically no difference for these sizes in the amount of steam per indicated horse power. If we take an automatic non-condensing engine, giving one indicated horse power for twenty-eight pounds of steam, we would have per brake horse power:

For 200 h. p. engine at 75 i. h. p.—53 lbs. per b. h. p.
For 75 h. p. engine at 75 i. h. p.—33 lbs. per b. h. p.
Difference—20 lbs. per b. h. p.

$20 \text{ (lbs.)} \times 67.5 \text{ (h. p.)} \times 8 \text{ (hrs.)} \times 365 \text{ (days)} = 3,942,000.$

If evaporating seven pounds water per pound of coal this gives 563,143 pounds, equals 281.57 tons. This at \$1.50 a ton equals \$422.35. In small stations, an evaporation of only five or six is often the average result, and the above amount would be proportionately increased. If we install a 75-horse power engine to take this light load

after the heavy load has gone off there would be no additional depreciation or repairs, because of having the additional engine; in fact, the total may be less, because there would be more time to adjust each engine. The engine, including foundation, would cost probably \$1,000 to \$1,300—extra piping and building (if necessary) possibly \$700; call this a total of \$2,000. The only additional fixed charges would be:

Interest on \$2,000 at 6 per cent.....	\$120
Depreciation on \$700 at 6 per cent.....	42

A total of..... \$162

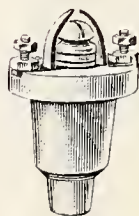
(and part of this is questionable), leaving a balance of \$260.35, equal to a trifle over 16 per cent. profit, additional to the 6 per cent. already allowed, besides obtaining a more reliable plant.

The Load and the Boiler.

In the majority of small plants, the engine, or engines, run for many hours at a very light load. Whether or not the addition of a small engine coupled to the same dynamos, or to an additional and smaller dynamo, would pay, can only be ascertained by a special examination into all the factors in each case. In one case a change was made by the advice of the writer, in the shafting arrangement, and the entire cost, including an addition to the building, was repaid in a comparatively short time. It is often said, even by engine men, "Do not get your engine cylinder too large—only large enough for the maximum work it may be called upon to do, and do not get the other parts too small." This refers to an engine for a variable load. The best proportions for a constant load are different, especially if the engine is compound, as to the ratio of the cylinder diameters. In some cases too low steam pressure is carried, and in others it would pay to condense. It is often a fact that the valve and piston leak, and that the valves are not properly set. Such losses may readily amount to 25 per cent. of the steam consumption, and not be accompanied by heating or pounding. How much can be afforded to save 20 per cent. of the steam? Practically 16 per cent. to 18 per cent. of the cost of the coal, being a little less than the 20 per cent., because some coal is used for banking and starting fires. A station burning two tons per day at \$1.50 per ton, or \$1,095 annually, can afford \$175.20, and even if this entire amount be spent, the engine will run better and with less depreciation.

(To Be Continued.)

NEW ELECTRIC GAS-LIGHTING BURNER.



The cut illustrates a new form of burner, or tip, to be employed in connection with series electric gas-lighting apparatus, otherwise improperly designated "multiple;" that is, a form of gas lighting in which a number of jets are to be ignited simultaneously, as employed in theatres, churches, etc. It presents a number of novelties. It is intended to be a substitute for the common lava tip in the ordinary pillar burner, or in what are known as candle burners, the base being arranged to fit the metal socket designed to receive and carry the common lava tip in either form of burners referred to. The novelty consists in the use of porcelain in the place of steatite or "lava," such as has been employed heretofore for such purposes.

It is claimed by the manufacturer that lava is a poor insulator where currents of high potential are employed, such as are produced by the frictional machine or Ruhmkorff coil, the usual generator in such cases. For this purpose porcelain has proven itself to possess far higher non-conducting characteristics and, further, is less liable to breakage, either through accidental blows or on ac-

count of increased temperature due to the flame. This makes the new tip more durable and lasting. The top of the body is provided with grooves, in which the electrodes are placed, which prevent the latter from shifting from their proper position, and thus changing or increasing the length of spark gap for which they are originally set. Another new feature consists in the means of attaching the circuit wires to the electrodes. Heretofore this has been achieved by providing holes in the electrode, which projected beyond the body of the burner. In the improved form screws with movable nuts are supplied, constituting practical binding posts, by which a sure connection can be made with great simplicity and ease, as well as neatness.

This new tip is being put upon the market by the A. L. Bogart Company, of 123 Liberty street, New York City, who are making a specialty of this class of apparatus.

EDUCATIONAL.

ELECTRICAL INSTRUCTION BY MAIL IN NEW JERSEY.

A meeting of exchange managers, switchboard men, linemen, and other employees of the New York & New Jersey Telephone Company, from Newark, Jersey City, Paterson, Hoboken, Orange, Asbury Park, Morristown and other places in Northern New Jersey, was held on the evening of the 23d ult. at the office of the New York & New Jersey Company, No. 185 Market street, Newark, N. J., when The Electrical Engineer Institute of Correspondence Instruction, No. 120 Liberty street, N. Y., was represented.

Mr. Alfred J. Wolf, of Brooklyn, N. Y., delivered an address, describing the plans, purposes and methods of the Electrical Engineer Institute, for conveying instruction by correspondence in the various branches of electrical engineering, and was followed by Mr. Henry W. Livingston, chief representative of the Institute, who called additional attention to the educational facilities afforded and to the convenient terms of payment for courses of instruction which the Institute allows. Mr. Edward E. Winters, formerly superintendent of the New York Light, Heat and Power Company, was also present at the meeting on behalf of the Institute and aided Messrs. Wolf and Livingston at the close of the meeting in entering a large number of enrollments of students, chiefly for the special course in telephony.

The institute has been so much appreciated by the officers of the company mentioned that a series of technical lectures by eminent electricians is in contemplation, to be given during the coming winter in Brooklyn, Jersey City and Newark, to harmonize with and make additionally beneficial the Institute's lessons. The enrollment of employees in the courses of the Electrical Engineer Institute, aided by these lectures, is intended to take the place of a very complete night school system, which was, until somewhat recently, in contemplation by the officers of the company, but which has now been abandoned in favor of the preferable and more practicable plan of correspondence instruction, properly administered.

POSSIBLE INSTALLATIONS.

Kansas City, Mo.—A power house will be erected by the Missouri Electric Railway Company. Address F. W. Sears, general manager.

Orangeburg, S. C.—Arrangements to receive estimates for the proposed electric light plant and water works will be made shortly by the commissioners of public works. Forty thousand dollars were voted recently for this purpose. Address J. G. Wanamaker.

Jacksboro, Tex.—An electric light plant, ice factory and cold storage plant will shortly be erected. A company has been incorporated for this purpose, capitalized at \$10,000.00; John Hensley, president, and J. E. Campbell, secretary-treasurer.

Fredericksburg, Va.—Plans and specifications for the city's proposed electric light plant are being prepared by D. F. Stokes, of Philadelphia.

Pine Bluff, Ark.—Walter S. Jeter can give information concerning erection of electric light plant.

New Orleans, La.—The Crescent City Electric Co. will erect a power station to be equipped with 1,000 kilowatts.

Monroe, La.—The Mayor may be addressed concerning proposed electric light plant.

Natchez, Miss.—The Natchez Gas Light Co. is extending its service.

Florence, Ala.—Frank M. Perry contemplates the establishment of an electric light and power plant in connection with several other enterprises now building.

Miami, Fla.—An electric light plant is to be established by Mr. Flagler.

Lawton, Mich.—City Clerk may be addressed concerning proposed establishment of electric light plant.

Gallatin, Tex.—City Clerk may give information concerning electric light plant.

Spartansburg, S. C.—The Aetna Light & Power Co., recently purchased by New York parties, will probably improve and enlarge its lighting plant and resume operations.

TELEPHONE CALLS.

New York, N. Y.—The People's Telephone Co. has been incorporated by S. B. Dutcher, J. E. Nichols, E. S. A. de Lima, Francis C. Travers, Frank Brainerd, J. Fred Ackerman, and Darwin S. James; to operate lines of telephone from this city to points within the United States and Canada. Capital stock, \$5,000, of which \$2,000,000 is to be preferred stock.

Little Rock, Ark.—The American Telephone and Telegraph Co., recently incorporated, will construct a telephone line from Little Rock to Memphis, Tenn.

Hazen, Ark.—The Grand Prairie Telephone Co. has been incorporated by George D. Foster, J. G. Thweats, J. M. McClintock, A. L. Aydiat and David Brockway. Capital stock, \$10,000.

Charleston, W. Va.—The National Automatic Telephone Co., principal office in Chicago, Ill., has been incorporated by John Anderson, E. W. Ober, W. W. Watson, C. A. Watson, L. A. Will, F. A. Lundquist and J. D. Milliken. Authorized capital, \$1,000,000.

STREET RAILWAY NEWS.

San Francisco, Cal.—Electrical Railway and Manufacturing Supply Co. has been incorporated by Samuel H. Taylor, Frank Frisbee and Henry P. Howel. Capital stock, \$50,000.

Kansas City, Mo.—The Missouri Electric Railway Co. will build a power house.

Cincinnati, O.—The Milford & Goshen Street Railway Co. has been incorporated by William A. Goodwin, M. C. Campton and others; to build and operate an electric railway in Hamilton and Clermont Counties. Capital stock, \$10,000.

NEW INCORPORATIONS.

Jersey City, N. J.—The Insulated Wire Co. has been incorporated by Samuel B. Laurence, John B. Summerfield and Burnham C. Stickney; to deal in insulated wire and other goods, wares, etc. Capital stock, \$500,000.

Montgomery, W. Va.—Kanawha Electric Co. has been incorporated with an authorized capital of \$25,000, of which amount \$500 has been subscribed.

BUSINESS CHANCES.

Electrolytic Marine Salt Company.—Alice E. Beckwith, of Boston; Nelson Edwards, of New York; Clarence D. Fulton, of Watertown, Mass., and others have filed a petition in the Supreme Court, at Portland, asking that a receiver be appointed for this company. They set forth that the idea of getting gold out of salt water is a fraudulent one, and that the money obtained for that purpose was secured by false pretences. A motion has been filed by the same persons praying that Arthur B. Ryan and others be enjoined from paying out any money or disposing of property belonging to the company. It is stated that the Rev. Prescott F. Jernegan is thinking of returning to this country from Belgium and making some sort of a settlement with the company, in which he is the chief stockholder.—Ex.

Toledo, Ohio.—The Toledo Electric Co. plant has been purchased by the Toledo Traction Co. for \$325,000.

Peoria, Ill.—The Diamond Electric Co. has been sold by United States Marshal Ames to George C. Bailey, of Chicago, representing the John Roebling Sons Co., of New York.

New York, N. Y.—Western Telephone Co., attachment for \$362 in favor of Elihu J. Granger.

Windsor, Ohio.—The Jefferson and Warren Telephone Co. has increased its capital stock from \$10,000 to \$20,000.

NEW YORK NOTES.

THE CITIZENS' ELECTRIC CONSTRUCTION & EQUIPMENT CO., of 39 Cortlandt street, report business as progressing. They are constructors of electric-light and power plants and are also agents for the well-known electric light and power apparatus of the Triumph Electric Co., Cincinnati, O. Mr. Frank R. Chinnoek, the president and general manager of the company, has en-

gineered some of the largest plants in the country, and has an excellent reputation as an electrical and constructing engineer.

R. A. BYRUS, manager of the Eastern agency of the Ohio Brass Co., of Mansfield, O., has opened up offices at 39-41 Cortlandt street, Room 59. He will carry a full line of his company's noted trolley materials.

L. O. FRORUP, of Schiff, Jordan & Co., 232 Greenwich street, has just returned from an extended trip through the South and reports good business. Mr. Frorup is well satisfied with his trip, having made a number of new connections and also opened up accounts with many large buyers.

THE ABENDROTH & ROOT MFG. CO., 28 Cliff street, report a large number of orders recently received for their Root's spiral riveted pipe. The great strength and durability of this style of water-pipe, the ease with which it may be handled, and the fact that it is not liable to give trouble through leakage, have created a steadily increasing demand for Root's Spiral Riveted Pipe. They have lately shipped to the Sheely & O'Shee Co., contractors, of Lincoln, Neb., 12,000 feet of their pipe which will be used in extending the water-works at Lanesboro, Minn. About 10,000 feet have been sent to Milledgeville, Ill., and 15,000 feet to the city of Augusta, Wis. The U. S. Water & Steam Supply Co., contractors, Kansas City, have placed an order with the company for about 5,000 feet of pipe which will be used at Concordia, Mo., and 6,500 feet are to go to J. L. White, contractor, Wyoming, Ill.

MR. M. COKELEY, probably known to many of our readers, has been appointed superintendent of the works of the C. W. Hunt Co., Staten Island, N. Y., and assumed the duties of that position on October 14th, after several months' work revising the factory systems.

Large concerns are beginning to relieve the office management of the responsibility of looking after the details in office routine, the installation of systems, methods, etc. This work properly belongs to a specialist; one who has become expert through constantly keeping his eyes open for improvement, studying the best literature on the subject and devoting his energies entirely to this work.

Mr. Cokeley has made this line of work his profession for some time, having been for many years with the General Electric Co. and later on with other prominent firms.

His experience as a practical mechanic has been of great benefit to him in this line of work, enabling him to detect almost instantly the leaks that invariably exist and which are so destructive to profits.

INVENTORS...

WHAT IS WRONG

With your invention? Why can't you get capital? We will tell you. You require endorsement by competent experts; we have them. If your invention has merit, our endorsement will enable you to get capital. Try us. Fees moderate. Correspondence solicited.

Address **ELECTRICAL AGE,**
Room 14, World Building, N. Y.

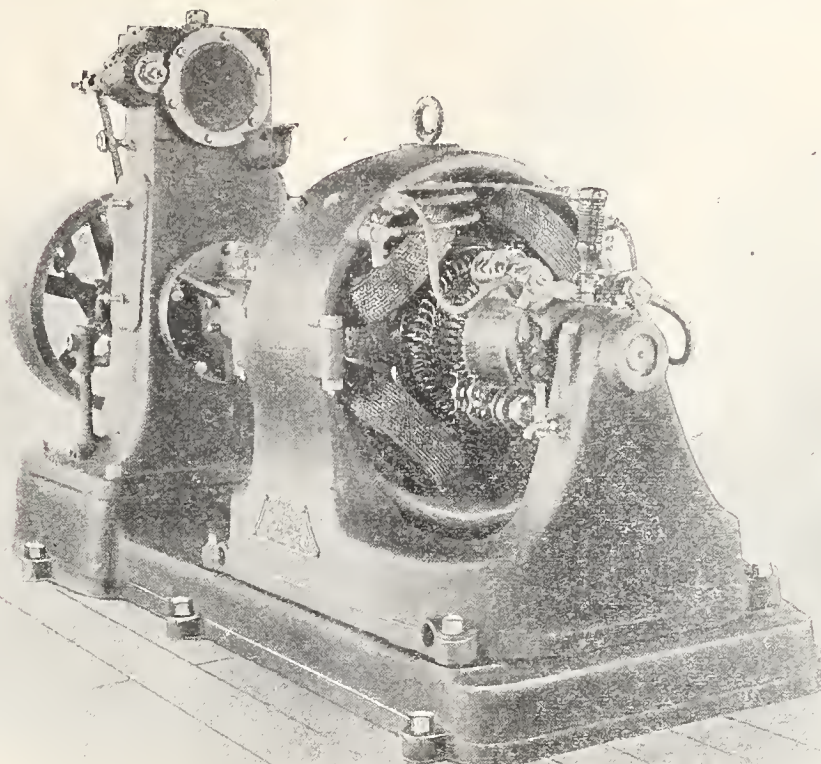


WESTON STANDARD
PORTABLE DIRECT READING
VOLTMETERS AND WATTMETERS
For Alternating and Direct Current Circuits.
The only standard portable instrument of the type deserving this name.

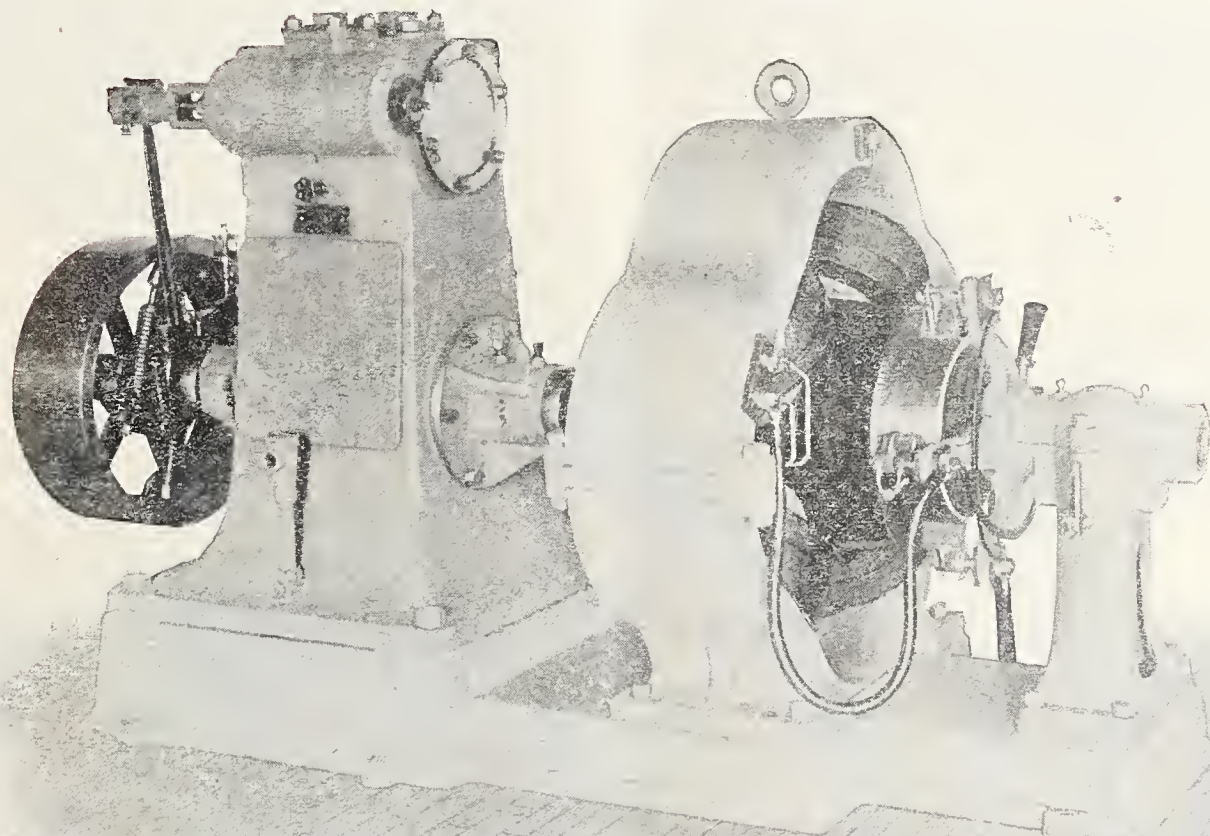
Write for Circulars and Price Lists
8 and 9.

WESTON ELECTRICAL INSTRUMENT CO.
114-120 WILLIAM STREET, NEWARK, N. J.

ELECTRIC LIGHT AND POWER.



Case Engine, Direct Connected to Keystone Dynamo.



Case Engine Direct Connected to Onondaga Dynamo.

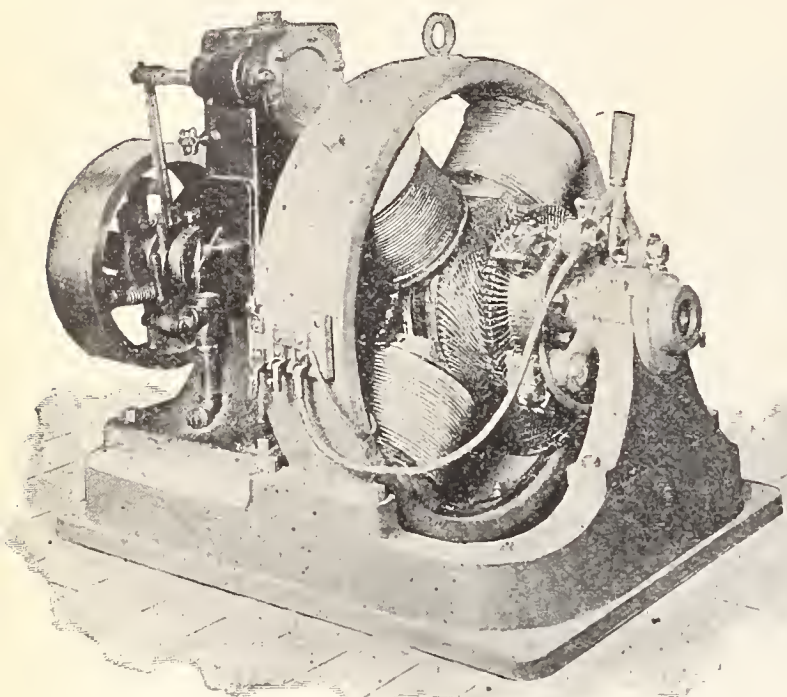
HIGH-SPEED ELECTRIC-LIGHT PLANTS.

Wherever there is civilization the demand for light has been in proportion to the stage of cultivation it represents. In large cities the streets are well lighted, and private residences and office buildings gleam at night with electric light. One of the most novel applications

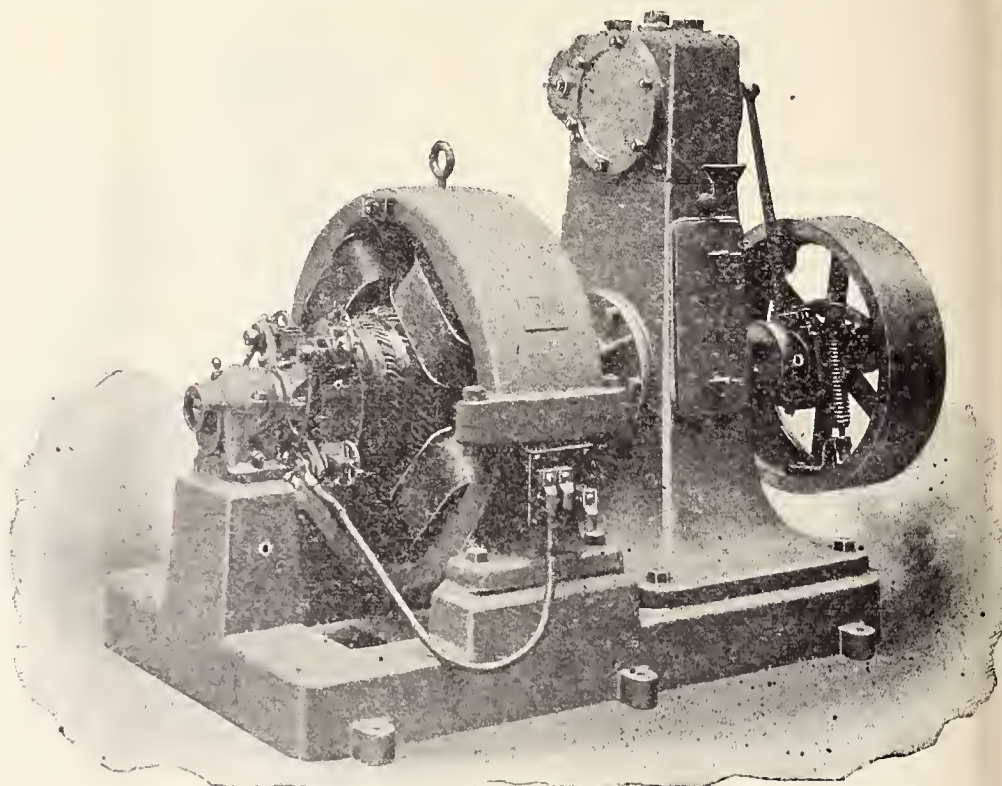
of electricity is to be found in the Buffalo Bill Company. This enterprising Westerner carries with him an entire electric-light plant which operates a glittering display of focussing lamps each night his entertainment is in progress. For four seasons Buffalo Bill has carried his sta-

tion with him, and with a brilliancy unparalleled has illuminated the arena so successfully that the sharpshooters, the dead shots, racing around on their wild bronchos, are able to make a successful play for the clay pigeons at

not cease here, but on board yachts, and even on some of the steamers plying the Yukon river in the far Northwest, the light weight, small size, high economy and excellent operation of these engines in direct connection



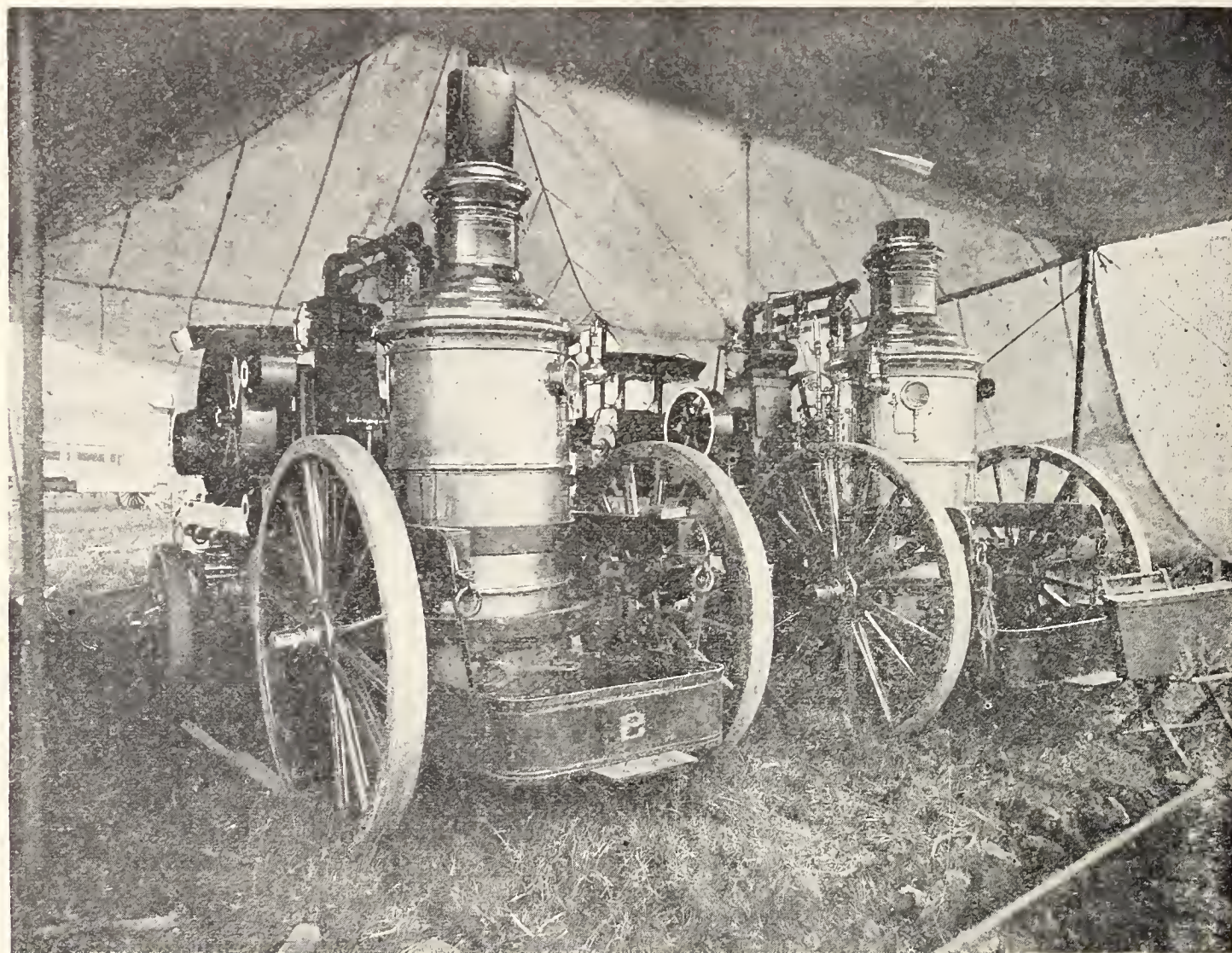
Case Engine Direct Connected to Riker Dynamo.



Case Engine and 7 1/2 Kilowatt Bernard Dynamo.

night. The accuracy of their aim is as good as in daylight, and at least five millions of the American public can testify to the success from an electrical standpoint

with dynamos have made them famous. The name earned by a mechanical device, and the reputation it is obliged to sustain, represents as much unconscious as



Two No. 5D Case Engines, Operating Lighting Outfit, Buffalo Bill's Wild West Show.

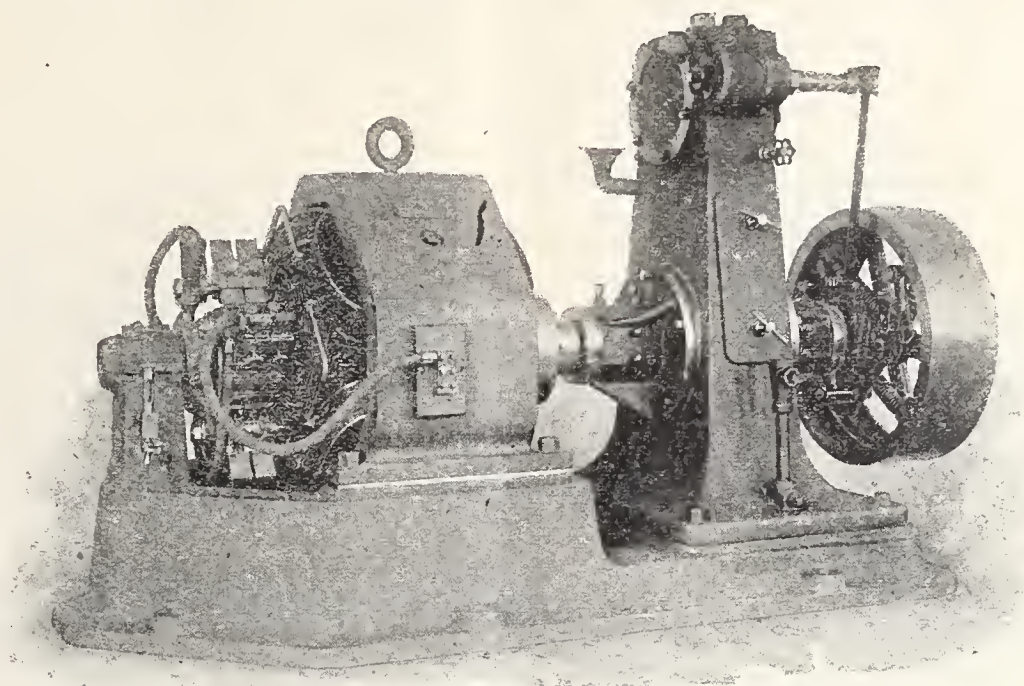
of Buffalo Bill's enterprise. The portability of his outfit is entirely due to the fact that the two Case engine-driven plants represent a degree of compactness and lightness hitherto unparalleled. The application of the Case engine for special cases of electric lighting does

that put forth by a living and thinking individual.

The remarkable adaptability and the possession of a series of superior qualities have made the Case engine peculiarly fitted for electrical light work. As far as compactness is concerned the Case engine, in combination

with a dynamo, possesses all advantages over others. This feature, however, is but one of its minor qualities. With a generator to which, as shown, it is direct-connected, the Case engine regulates so that a fluctuation in speed never occurs, and the voltage supplied by the dy-

Competition is truly the spirit of business, not only from the layman's point of view in forcing prices down to their lowest, but in bringing upon the market machinery which invariably denotes care and judgment in its design and economy in its operation. Competition gives rise to



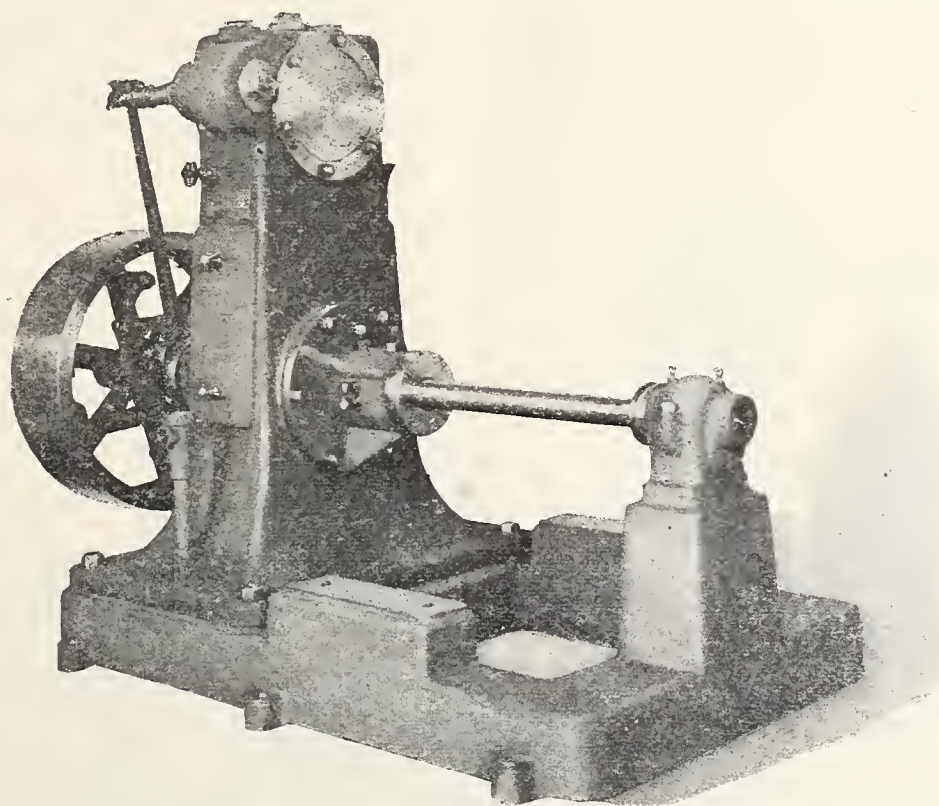
Case Engine, Direct Connected to Eddy Dynamo.

namo preserves an unvarying uniformity. Under such circumstances a light that flickers cannot be produced; the steadiness of the illumination engendering perfect satisfaction to the purchaser.

Where floor space becomes a matter of great expense, it is highly likely that considerations relating to the area

a demand on the part of the public for machinery requiring a minimum of care and attention—a simplicity in construction that brings with it long life and durability to working parts.

From a purely technical standpoint the Case steam engine, in direct connection with any of our well made



Engine and Sub-base Fitted with Bernard Dynamo Used on U. S. Government Contract.

occupied receives first consideration in the eyes of possible installers. In such a case common sense dictates the use of machinery whose factor of economy must not only be considered but the floor space it occupies as well.

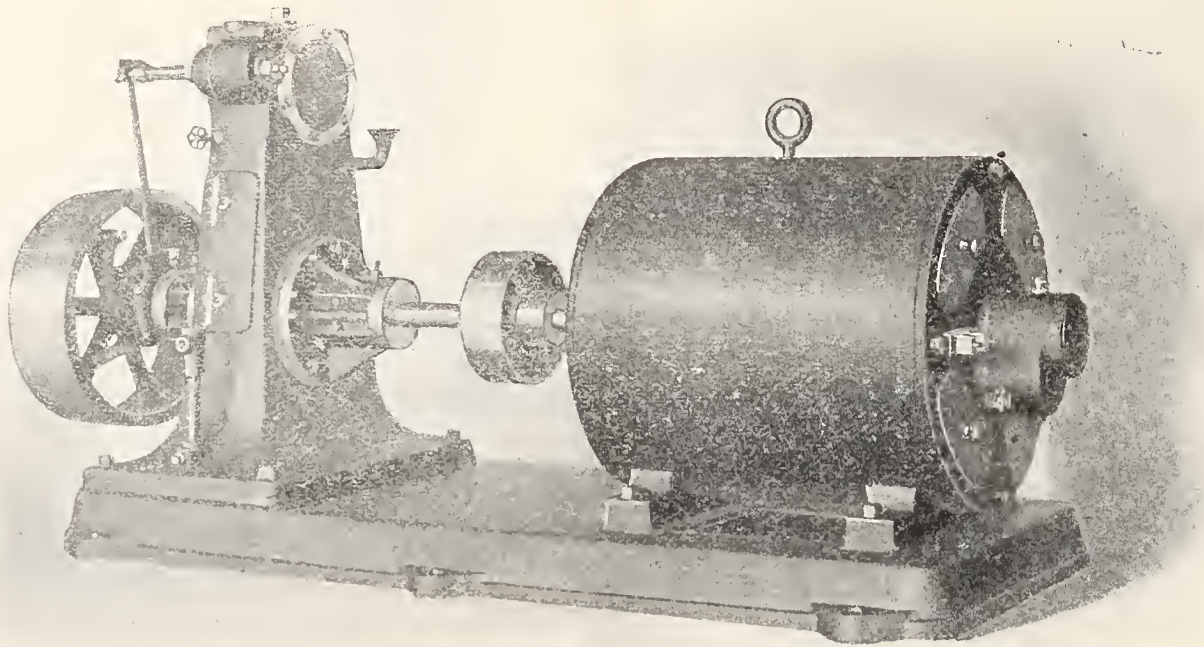
One of the original difficulties experienced in the early history of electric lighting may be traced directly to the use of plants requiring an extensive area for their installation. Practice, however, has so changed, that size, weight, economy and floor space are considered collectively. Therefore electric-light plants deficient in any of these respects do not comply with the requirements of engineering practice and must meet with opposition, when their installation is completed, if at all deficient.

generators, comprises a plant which possesses all the features outlined above. It forms an outfit of great simplicity, occupying but little room and requiring but occasional supervision on the part of an attendant. The automatic oiling feature is noteworthy, and, notwithstanding the engine's compact form, everything is readily accessible; the character of workmanship no less than the size of the bearings and light-moving parts contributing to its smooth running qualities under all changes of load which are promptly met by a refined governor. These engines are made in sizes of from two and one-half to twenty-five horse-power.

The valve motion, oiling devices, governor, bringing

about perfect regulation and general economy make it only necessary, in order to possess a perfect lighting plant, to attach it to an Eddy, Lundell, Crocker-Wheeler, Bernard, Bullock, or other standard type of dynamo. The smooth operation of an electric light in a purely mechanical sense is perfectly useless unless attended by a

railroad train, installed by the St. Charles Car Company, have given excellent satisfaction. In summer the advantages of this system are eloquently proclaimed by passengers, travelling back and forth, to whom the absence of a vitiated atmosphere, ill smells from oil and gas and the danger attendant upon their use means a pleasure untold.

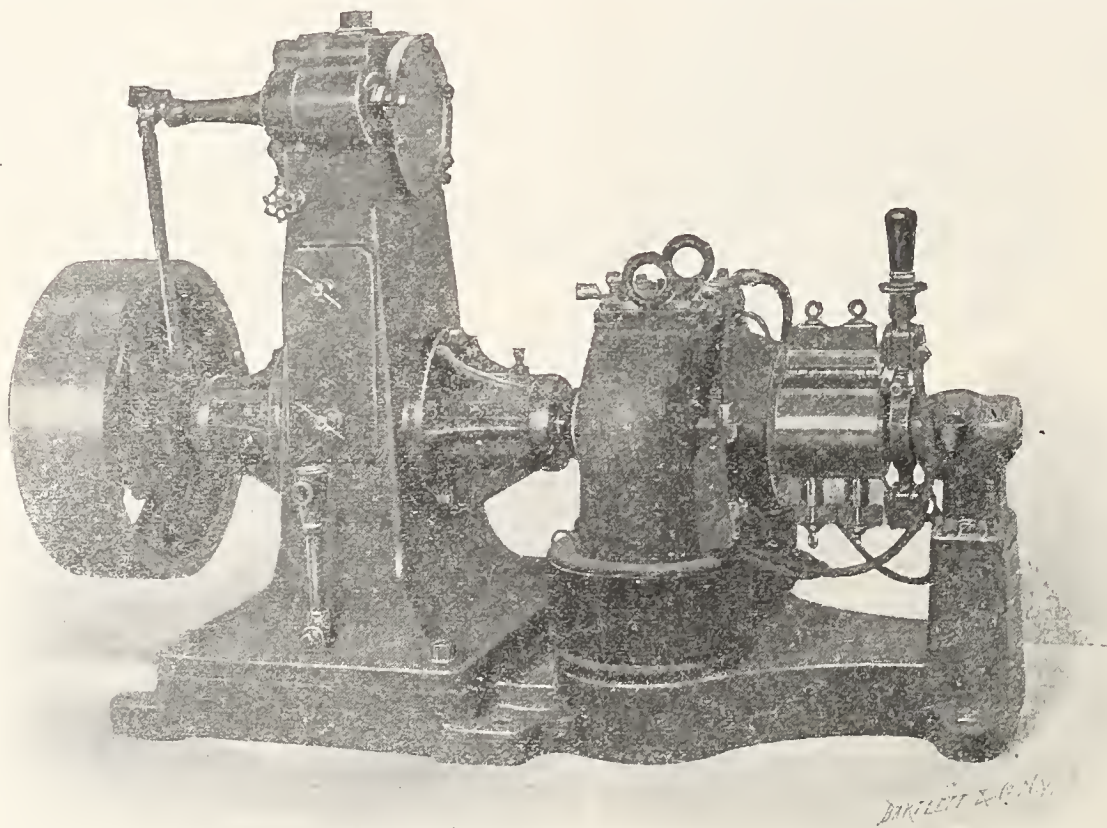


Case Engine, Direct Connected to C. & C. Dynamo.

similar smoothness in operation on the part of the dynamo when subjected to sudden changes in load. This in itself in the main is a test that every installation must pass through before it can be considered above criticism.

For special lighting, isolated plants, marine lighting, factory lighting and train lighting, the New Britain Ma-

Electric lighting, according to the most modern methods and involving the use of high-class machinery, is no longer either an experiment or a luxury. Electric lighting has like all luxuries, by the prevalence of its use, become a necessity, and it is only natural for those desirous of employing this useful servant through a belief



No. 4 Case Engine, Direct Connected to Crocker-Wheeler Dynamo.

chine Company have met with unusual success in introducing their Case engines co-operating with dynamos. For train lighting particularly such a plant may be carried in the end of the baggage car, supplied with steam from the locomotive, and will hold its speed and give light, which will contribute materially to the luxury of modern railway travel, entirely independent of the train's motion. The engine and dynamo running on a Texas Midland

of this kind to obtain the most compact and most efficient machinery the market affords. The New Britain Machine Company, of New Britain, Conn., manufacture the Case engine, and we advise prospective purchasers of electric-light plants with limited floor space, limited allowance for weight, etc., to correspond with this concern.

The Case engine also played quite a part during the late Hispano-American war. The tender "Mangrove,"

The Electrical Age.

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THE INCREASING USE OF THREE-PHASE MACHINERY.

The labors of Tesla, Dobrowolsky, Bradley and others have not been without their influence in developing what has now become one of the greatest departments of electrical engineering. The close of this century embraces the efforts of many great scientists, the work of each being consistently practical and in every way assisting in the crystallization of certain principles fit for different commercial applications. No problem seems more difficult to solve than that relating to the efficient generation, transmission and distribution of alternating currents, yet the very difficulties presented were but stepping stones to ultimate success.

Three-phase and polyphase machinery is accepted as the true solution in practice of one of the greatest problems of the age, the transmission of electrical energy. Niagara Falls, the power of which has dissipated itself for untold centuries upon the yielding rock, has now been curbed and bridled, and part of its resistless spirit flows with rapid pulsations into the heart of Buffalo. In regions further west, where the picturesque grandeur of the scenery is only relieved by gigantic mountain tops, where the hammer and pick do their work into the heart of rocky precipices, the thread-like lines leading from some distant station transmit the power which assists the miner and refiner of the crude ore. In many cases, where to obtain power other than electricity is well-nigh impossible, the great and palpable advantages of the three-phase system of transmission are so evident that in the majority of cases along the Pacific slope and further north to the very confines of this territory the alternating-current polyphase plant fills a want that has existed since the days of Tubal Cain.

A great deal of our industrial work in the West, the benefits of which have been felt along the eastern coast as well, has been stimulated to a healthy growth by the use of cheap and convenient power transmitted as electrical energy. One of the most startling innovations of modern times is that relating to the use of wave motion.

The possibilities of generating power from the force of the waves open up new vistas of prosperity. This power transformed into polyphase currents may be sent from large stations erected at the water's edge to innumerable towns and villages in the near vicinity. Illumination of the brightest kind will prevail at night, and power would be used ad libitum by those following an occupation allied with the manufacturing arts. The flexibility of this electrical system of generating and transmitting energy has added to the world's quota of good things that which will mean busy factories, heavy shipments of machinery and the employment of skilled and unskilled labor on the largest imaginable scale.

Side by side with the manufacture and application of polyphase machinery may be found a great burst of industrial activity on the part of those that manufacture water-power appliances. Thus it is that hand in hand a healthy growth in one branch of science brings about a corresponding development in another.

All of our great and glorious West is under the spell of the electrician. Water power plants reign supreme, and the magic touch of Progress has given new life to some small and sparsely settled locality that required the influence of a new and prospering art to bring about a change for the better. Not only need the electrician be thankful to those that have given us our present system of polyphase transmission and the machinery its use entails, but the world at large, and particularly those sections of it undergoing improvement, should thank those that have given to them the ready means of industrial advancement.

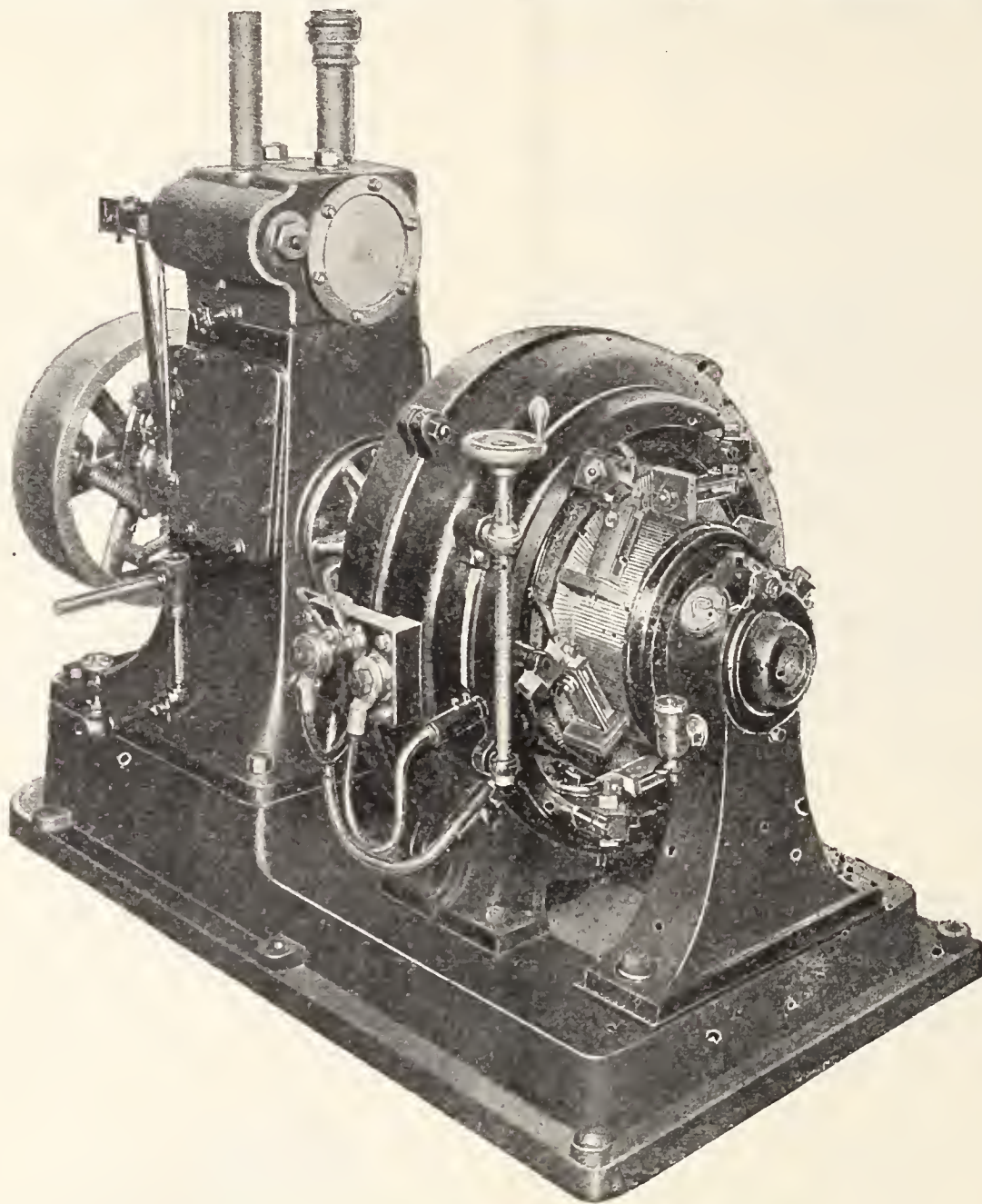
The ratio of increase in wealth is in many respects in direct proportion to the manufacturing capacity of a land, and this manufacturing capacity, this power of turning out new and improved types of machinery, depends specifically upon the minds of such men as those mentioned above. The standard of invention is raising year by year, and the combinations and recombinations daily occurring and patented by the thousands each year will soon give rise to a degree of civilization unutterably beyond any that has previously existed. As the cable has welded together continents so that they have become as one, so will the inventive ability of our citizens bring into closer touch the elements composing this great Republic. The hour is ripe for great departures, and it is our pleasure to state that among the noted inventions displayed at the coming Paris exposition few will excel in simplicity and value those relating to the use or generation of polyphase currents.

Nernst, of Goettingen, has invented an incandescent electric light in which the filament is of the same material as that used for the mantles of the incandescent gaslight. The production of the necessary temperature requires a smaller current with the new filament than with the carbonized filaments already in use, and there is no need to have the filament in a vacuum.—Ex.

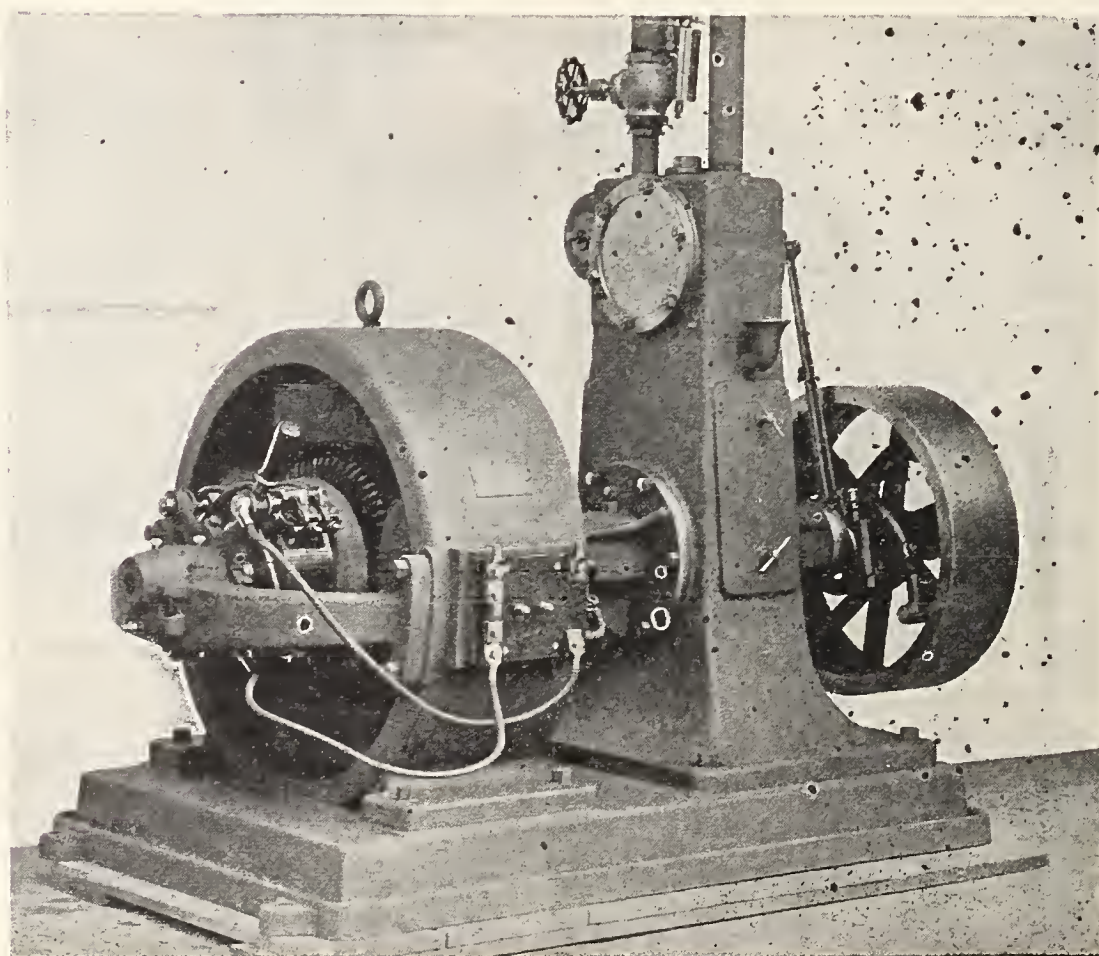
The possibilities of electrical combination locks for cash drawers and similar receptacles does not seem to have been realized to its fullest extent. It requires but little ingenuity to arrange four or five push buttons in such a way that only one combination will close the circuit of an unlocking magnet, and any other will ring an alarm. The alarm could be placed at any convenient point, and at other points could be placed cut-out switches which, when manipulated, would render it impossible even for one who knew the combination to succeed in opening it. The device is easily developed and marketable.—Ex.

the first vessel to be sent to Cuban waters after the destruction of the battleship "Maine," was equipped with a first-class electric light plant, the motive power of

which was furnished by a Case engine. The divers engaged in the task of examining the hull of the ill-fated vessel were greatly hampered by the muddy waters for



Case Engine, Direct Connected to Lundell Dynamo.



Case Engine Direct Connected to Bullock Dynamo.

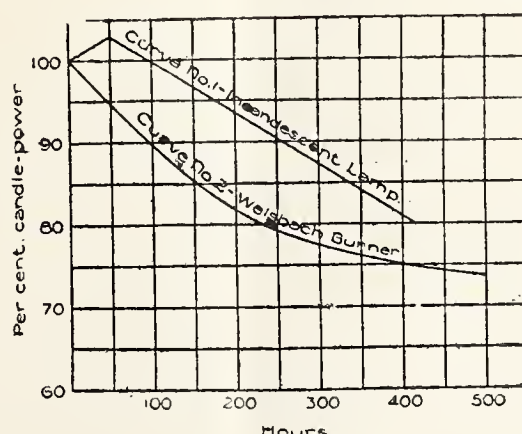
which the bay of Havana is notorious, and which made seeing under water an impossibility. Upon learning of the arrival of the "Mangrove," the divers hit upon the idea of using the current generated by the "Mangrove's" electric light plant for lighting beneath the water, which plan met with the greatest success and enabled them to arrive at the desired result. Naval Constructor Hobson's operations at Santiago in raising the sunken Spanish ships are being facilitated by the Case engine driving the searchlight on board the wrecking tug.

Lieut. Peary also took with him on his Polar expedition a four H. P. engine to drive a dynamo for furnishing light for his Greenland hut during the long Arctic night.

LIGHTING.

DEPRECIATION OF CANDLE-POWER OF WELSBACH MANTLES.

Gas companies have very generally claimed that the mantles used with Welsbach burners maintain their candle power practically constant until the mantles are destroyed. Recent investigations, however, show that the depreciation of candle power in Welsbach mantles is as rapid, or even more rapid than in the filaments of incandescent lamps. The accompanying curves show the average results of a series of tests made on incandescent lamps of General Electric manufacture and Welsbach burners.



Curve No. 1 shows that a good 32-C. P. incandescent lamp burns 415 hours before its candle power drops to 80 per cent. of the initial value. Curve No. 2 shows that a Welsbach burner suffers the same depreciation in only 230 hours. In other words, the depreciation of the Welsbach mantle is so much greater than that of the incandescent filament that the Welsbach burner drops to 80 per cent. of its initial candle power 185 hours sooner than the incandescent lamp.

Economy dictates the substitution of a new incandescent lamp when the initial candle power has depreciated to 80 per cent., but taking into account the high first cost of Welsbach mantles and the low cost of operation, a mantle would undoubtedly be continued in use until its candle power had dropped much lower. In this case, the customer would be obliged to consume the same amount of gas, and thus be at the same expense, although the light obtained would be much diminished in power. For example, if a Welsbach mantle having an initial candle power of 32 were burned for 500 hours, its candle power, according to the curve, would drop about 27 per cent., leaving approximately 23.4 candles.

Attention has recently been called to this interesting subject by the following quotation from an English paper:

"In view of the extending use of the incandescent system of gas illumination and the unequal illuminating power which has been experienced with mantles of various kinds, any really scientific investigation into the relative value of different mantles is a welcome addition to our stock of technical information.

"An interesting report of a number of tests of such mantles is given in the 'Electrical Review' (London, December 10, 1897) by Mr. E. A. Medley, with much valuable information in general about incandescent gas lighting. Mr. Medley had made some tests on the Incandescent Gas Light Company's mantles as long ago as 1893, and these he refers to as showing the improvement which has been made since that time. The tests referred to in the present report were made in Berlin, and include not only the two English mantles of the Sunlight and the Incandescent Gas Light Companies, but also those of the German concerns, including Die Deutsche Gasgluhlicht Aktiengesellschaft, Die Neue Gasgluhlicht Aktiengesellschaft, and the Stabil Mantle.

"The standard of light used was the Heffner amyl acetate lamp, in connection with a Lummer-Brodhun photometer, the gas being measured by an Elster experimental gas meter. Much care was taken to secure uniform and reliable results, the room being thoroughly ventilated, and draughts at the same time avoided, as it has been found that the light is materially affected if there is not an ample supply of fresh air. The horizontal candle power was measured in three directions, 120° apart, and the mean taken as the correct reading, the measurements being taken every twenty-four hours. The details of the tests are given in full in the paper, and we can here give only the final table, which contains practically all the important results. It will be noticed that one of the German mantles, the Stabil mantle, is decidedly superior to any of the others either English or German.

NAME OF MANTLE.	Candle power.			Percentage Fall.	
	New.	100 Hrs.	500 Hrs.	In 100 Hrs.	In 500 Hrs.
Sunlight Company....	36.	33.4	14.	7.2	61.2
Incandescent Gas Light Company....	52.9	49.	29.7	7.4	43.8
Deutsche Gasgluhlicht Aktiengesellschaft..	70.3	49.7	28.2	29.3	59.9
Neue Gasgluhlicht Aktiengesellschaft....	53.5	40.3	33.3	24.7	37.7
Stabil Mantel.....	62.6	57.1	47.5	8.8	24.1

"An important feature in connection with incandescent gas burners is that of the proportion of the size of the mantle to the Bunsen burner. In many cases the mantle is much too large for the burner, and, in consequence, does not become properly incandescent all over; it also shrinks and warps out of shape to a much greater extent than when smaller. Tests also showed that the light absorbed by mica chimneys as compared with glass was as much as 9.4 per cent.

"Mr. Medley's general conclusions are summed up as follows:

"The mantles give a wonderfully good light when new, but the extreme rapidity with which the light falls off and the consequent shortness of their efficient life, even when treated with every consideration due to their some-

what delicate constitutions, makes them far from an ideal illuminant. With the possible exception of the Stabil mantles, a great deal of improvement is necessary before, for domestic lighting at any rate, they can be considered even satisfactory."

The depreciation of candle power of mantles in the Welsbach system should be thoroughly considered in connection with the heat given out, consumption of oxygen from the air, contamination of the air, inconvenience of lighting, danger from fire, and other disadvantages which are common to any gas system.

The enclosed arc lamps which the General Electric Company has developed give all the advantages of an electric system of illumination, and at the same time the cost per candle power of the light is much lower than with the Welsbach burner or other illuminants. In fact, present indications are that enclosed arc lamps will eventually replace all Welsbach burners.

OPINIONS OF EXPERTS.

THE PRESENT STATUS OF ELECTRICAL ENGINEERING IN THE UNITED STATES.

By Dr. A. E. Kennelly.

(Continued from page 224.)

The principal engineering value of electricity today lies in its adaptation to the transmission of power through mills or cities, or from some locality where power is cheap to others where it is dear. A steel rope by its bodily motion can transmit, with appreciable friction and depreciation, some hundreds of kilowatts to a distance of some thousands of feet. A bare quiescent copper rope, one-half inch in diameter, and supported on poles, can by maintaining an effective potential of 10,000 volts by the motion of electric waves over its surface, transmit, say, 2,500 kw. with an energy loss of two-thirds per cent. per mile, and with practically no depreciation except that of the poles and supports.

The use of high pressures has thus become more frequent during the last few years. Alternating-current generators are now made to supply 10,000 volts at their terminals, and insulation testing sets have been made for producing alternating pressures up to 100,000 volts effective.

The application of electric power to domestic use and household comforts, irrespective of illumination, has made steady progress. In the large cities the fan-motor day load of summer is, in the aggregate, a perceptible quantity, while electric ranges and heaters on a small scale have found favor through their convenience.

In telegraphy, comparatively little change has recently taken place beyond the substitution of the dynamo or dynamotor for the voltaic battery, and of copper-line wire with some five ohms per mile for iron wire with some 13 ohms per mile. About 1,000,000 miles of telegraph wire are now strung on about 200,000 miles of pole line in the United States, connecting about 25,000 offices, and working an invested capital of about \$150,000,000.

In the United States, the uniformity of the closed-circuit Morse system, simplex, duplex, or quadruplex, is varied only by an occasional Wheatstone set. This crystallization of methods is not due to any lack of invention or capability of improvement in signaling speed, but rather to the apparently settled belief that the present systems are the most economical under existing conditions of traffic. In long submarine telegraphy, the pressure of increasing traffic has made itself more distinctly felt, but the physical difficulties in the way of attaining high speeds have, as yet, been obviated only in part by an increased expenditure in copper and gutta-percha, to obtain a diminished conductor resistance per mile. Wireless telegraphy has entered its experimental

stage, and bids fair to enter practical service in the future, at least within a limited range.

In telephony the most notable improvement in recent years has been the general substitution of metallic circuits for ground return circuits, with great advantage to the convenience and effectiveness of the service. At the present time conversation is carried on commercially up to a distance of 1,800 miles, and quite frequently at distances of 1,500 miles. There are at the present time in the United States about 1,000,000 telephones connected with the telephone service of the country, employing a capitalization of about \$100,000,000, 400,000 stations, and about 900,000 miles of wire. Every day about 17,000 employes make on the average more than 3,000,000 connections. About 300,000 miles, or nearly one-third of the total length of telephone wires, have within the last few years been made up into aerial and subterranean cables, within city limits, owing to the reduction of the electrostatic capacity effects in such cabled wires to less than one-twelfth of a microfarad per mile.

A considerable development has occurred in electro-thermic and electrolytic processes. More than 4,000 kw. of Niagara power are now employed in such processes. Among electro-chemical processes are the electrolytic refining of copper to the extent of about 150,000 tons annually, the production of aluminum, the production of sodium and alkalies, and the treatment of ores. Among electro-thermic processes are the production of the carbides of silicon and calcium in steadily increasing quantities.

In electro-technical theory considerable advance has been made of recent years, particularly in the study of alternating currents. Accompanying the expansion of knowledge in the various branches, there is a tendency among them to combine and unite into one general theory. Thus, while the low-tension electricity of dynamo origin was once regarded as something so dissimilar to high-tension electricity as to require separate treatment and classification, today the high tensions derived from alternators through step-up transformers so far invade the territory of so-called frictional electricity that a dividing line between the two classes can no longer be maintained. Similarly telephony and telegraphy are coming to be regarded as sub-classes of alternating-current power transmission, while electricity and magnetism cannot properly be studied apart.

VACUUM TUBE LIGHTING.

THE THEORY OF SUNLIGHT.

Experiments made recently by Francke L. Woodward, Harvard, '96, to determine the penetrability of a vacuum by light, have led him to conclude that, owing to the presumable vacuum existing between the atmosphere of the earth and that of the sun, the rays generated by the sun must be a form of cathode rays, or we would get no sunlight whatever. The theory is radical, and, if confirmed by other experimenters, will set at naught the accepted ideas of transmission of light through space.

The investigator used a glass tube, exhausted of air as much as is today possible, covered with black paper, in which were cut two circular openings at opposite ends of a diameter to enable the passage of light. A beam of lime light was sent across the tube through these openings. As it left the second opening its intensity was only about one-twentieth of that it had on entering. It was found that the more perfect the vacuum the less was the intensity of the light. It would therefore seem that, granted an actual vacuum were obtainable, no lime light whatever would emerge from the second opening.

Next cathode rays were sent through the tube. They came out of the second opening with almost the same intensity they had on entrance, proving the penetrability of

the X ray. This tends to support Tesla's theory that Roentgen rays consist of a stream of material particles capable of passing through the glass walls of a bulb. When these particles enter the bulb the transmission of light is facilitated. It would follow from this, then, that light can only be transmitted where material particles as well as ether are present.

In regard therefore to the transmission of light from the sun to the earth, it seems reasonable to conclude, in view of his experiments, that if, as is supposed, a perfect vacuum exists between the sun and the earth, the rays of light generated by the sun are transformed in traversing this vacuum and our atmosphere.

There are also some astronomical and meteorological phenomena which support the theory of the existence of a cathode stream from the sun. According to the theory of comets, which is now most in favor, tails of comets are due to a cathode stream, such as Crookes found to proceed from an obstruction placed in the main cathode stream. The aurora borealis has also been explained by Birkeland on the assumption that it consists of cathode streams in the upper region of the atmosphere, directed and controlled by the earth's magnetism.

(To be continued.)

ELECTRIC LIGHT AND POWER.

POSITIVE AND NEGATIVE ECONOMIES IN THE OPERATION OF SMALL ELECTRIC LIGHT PLANTS.

(Continued from Page 236.)

Everyone knows that a good fireman can save 25 per cent. to 50 per cent. of the coal used by a poor one, or by the good one if he is not intelligently checked. This last remark is not always added. Possibly the heating surfaces are not kept clean inside and out—a conservative estimate of loss is 5 per cent. to 15 per cent. Next, that the settings are not tight—loss 2 per cent. to 5 per cent.; grates too large or too small, with fires too thin and in holes, or too thick for the draft and the coal—loss 10 per cent. to 20 per cent. Perhaps coal at \$1.25 a ton is being used and evaporating less water per dollar than coal at \$1.50. Possibly changes in the furnace would reverse the case and the \$1.25 coal would be a positive instead of a negative economy. Often the feed water is at a lower temperature than necessary, possibly saving up to 15 per cent. Perhaps a new boiler is needed, or a larger stack. The saving to be effected and the cost can be closely approximated.

Voltage.

We will next consider the electrical end. Whether A. C. or D. C. be used for incandescent lighting, the great point is to deliver at constant pressure. If the consumer furnishes his lamp renewals, it may not seem to be of great importance, but from the standpoint of giving satisfaction, it is second only to reliability. The voltage at the lamps in most town plants, and in many city plants, has, I believe, a fluctuation of over 10 per cent., and in some cases of 15 per cent. A range of not over 6 per cent. is exceptional. In very few plants is the fluctuation known, and in nearly every case where ascertained by the writer, it has been a great surprise to, and hardly credited by, the client. Most stations have a lamp breakage of 20 per cent. to 40 per cent. in excess of the amount readily obtainable.

I have some curves on this point which may interest you. In order to improve in this particular, a study of the conditions of operation, and record of voltage at a number of places is necessary, and often a great improvement can be made at a slight expense. In one case—a plant of about 3,000 lights—we found part of the town

operating at a very high voltage, "because they had to for another part of the town;" 110-volt lamps were seen in use, 125 volts being noted in some cases, 100 in others. It cost about \$150 to add a little wire and to take down wire in one place and put it in another, and bring the whole network so that it would rise and fall together. This was a direct-current plant. In an A. C. plant of about the same size, the difference of voltage between the different parts of the circuit, and the hourly variation, was still greater. In some places the lamps would not last, and no one was satisfied. It cost \$100 to plan changes costing another hundred, and to save several dollars a day, and, still more important, satisfaction was given.

In both these cases the voltage at the station was maintained practically constant, without reference to the load, and this is a common error. Changes, to produce good results, cannot always be made so cheaply as in these cases, but generally the distribution can be improved and placed under control without an excessive expenditure.

If A. C. is used, it is important to have as large transformers and as few of them as practicable, often feeding into a network, at least in the business portion. This has been much discussed recently, and especially in the paper by W. F. White, read at the Omaha meeting of the American Institute of Electric Engineers.

Under the head of "The Devices for Transforming Electric Energy into Light or Power," the savings to be effected are largely dependent upon the distribution. High efficiency incandescent lamps, that is, those requiring the minimum watts per candle power, cannot be used if the voltage varies. The maximum difference of potential in the arc cannot be maintained, nor satisfactory light given, by constant potential arc lamps on varying voltage. Motors will not govern well if the voltage drops, and would take an excessive current if forced to do the same work as at a higher voltage. For constant current arc lamps, the rated current must be maintained. Keeping the mechanism clean, not wasting carbons, and similar details of operation, are points to watch.

Making Improvements.

To ascertain the true condition of any plant, it is necessary that it should be carefully tested by some one having a broad knowledge of such matters. He should have, not only a training as an engineer, but also as a station man, being able to discriminate between efficiencies under special conditions (important as it is to know same) and the efficiencies which can be expected in regular run, and how far it is practicable to improve same.

In conclusion: Ascertain the facts as to the present condition of operation, make such improvements as possible by better adjustment or handling.

Make such additions as will bring 15 per cent. or more on the investment, at the same time adding to the reliability and lessening the depreciation, and as fast as the necessary money can be obtained to pay for them. Keep records and study them. Obtain and maintain a desire on the part of the employees to better the record.

Our principal manufacturing companies freely advertise and guarantee the specific economic performance of which each and every one of the transformers that they place upon the market is capable. They severally advertise to supply us with transformers equaling in efficiency, regulation (and what not), any other transformer that can be found upon the market.

The manufacturing companies are unanimous in their guarantees of high efficiency, low core losses, negligible ageing and close regulation. If we can purchase transformers freely on these representations, with sufficient guarantee that the specifications advertised are strictly conformed to or improved upon, there is little to be desired on the part of the purchaser over and above what is offered. Any slight improvement that it shall be possible to make upon the best of the performances advertised by the competing factories will be forthcoming in consequence of the rivalries of trade, and the purchaser need

only seek now for means of protecting himself against occasional faulty manufacture.

When, therefore, we consider the perfection to which this type of apparatus has been brought, in its every detail, and in sizes varying in capacity from a fraction of one to over 800 kilowatt, we have cause for congratulation.

If you have followed the design and manufacture of the commercial transformer, I think you will admit that at the present time the best of them are figured just about as close as is possible, and in fact we have almost reached the point beyond which any further advance in the direction of improved efficiency must be made by getting better insulating materials, requiring less space and giving this space to the iron and copper.

With a view to investigating the present status of the transformer and the ability of transformer manufacturers to meet in all cases the exacting specifications which they have laid down for themselves, I have had a number of transformers of recent design tested in the Purdue laboratories within the last year. The results of these tests are especially gratifying when gauged from the standpoint of our present commercial requirements, and to the specialist a detailed statement of the results would be interesting. In view of the fact, however, that the electrical literature of the day contains numerous matters of this kind, I will not bore you with many figures, but rather discuss the results in a general way.

With but one exception the transformers tested have surpassed the requirements of the specifications laid down by Prof. Jackson in his excellent article on transformer testing, with which we are all familiar, and, generally speaking, they have conformed fairly closely to the published guarantees of the companies submitting the transformers for test. To what extent this is true may be better appreciated if I cite one or two examples.

A 2.5 kilowatt transformer was submitted for test that was guaranteed to conform to or improve upon the following specifications: Core loss 48 watts, regulation 2.1 per cent., and full load efficiency 96.1 per cent. The test of this transformer gave, core loss 42.19 watts, regulation 1.9 per cent., full load efficiency 96.2 per cent.

The showing made by this transformer is good. The core loss is 5.81 watts less than the stipulated value, and the efficiencies are in excess of the stipulated values. In this case the manufacturers more than substantiated their guarantee, and supplied a transformer that is a greater revenue producer than the specifications call for. If the core iron of this transformer can be relied upon as not materially increasing in its hysteretic loss with age, it is an easy matter to figure the money value of the excess economy that the transformer develops.

Suppose, for instance, a contract should be made for 40 of these transformers at \$30.00 each to meet an increase in a station load of 100 kilowatts. On an all-day schedule these transformers would probably carry a commercial load equivalent to full load working for five hours. This assumption may seem to represent a better condition of service than is usually met with in practice, but it is an assumption that is fair to the manufacturer in considering the all-day efficiency. The transformers would therefore be working under no load for 6,935 hours and under full load for 1,825 hours per year, and under the conditions of the test would save 1,794 kilowatt hours to the station. If we figure the cost of producing this power at two cents per kilowatt hour, the saving per year would be \$35.88 for the forty transformers, or practically 3 per cent. on the amount invested in the transformers. If this power were sold for six cents per kilowatt hour it would represent a net gain to the purchaser of $1,794 \times .06 = \$107.64$ per year more than he had any right to expect under the contract specifications.

Another 2.5 kilowatt transformer submitted for test is advertised by the makers to show a core loss of 57 watts, a quarter load efficiency of 91 per cent., a full load efficiency

of 96 per cent., a regulation of 2 per cent., and a no load current of .1 ampere. Under test it was found to have a core loss of 63.6 watts, a quarter load efficiency of 90 per cent., a full load efficiency of 94.8, a regulation of 3 per cent., and a no load current of .087.

Suppose we estimate the economy of transformers of this type just as we did those of the type previously considered. The 40 transformers, working on the same schedule, would waste 4,014 kilowatt hours more power than they should under the specifications advertised. At two cents per kilowatt hour the total money loss would be \$80.00 per year, or over 6.5 per cent. of the cost price of \$1,200.

Many engineers may claim that the cost of checking up the performance of the transformers would more than eat up the saving effected by the small margin that these results represent, and in many cases under the present organization this would doubtless be true, but if a well-advised stand was taken by the central station managers for mutual protection, the result would be markedly beneficial.

A percentage of the transformer output of each of the manufacturing firms could, for instance, be tested in some one place, where a record of the individual performance of all the transformers submitted for trial could be kept, and not only efficiency, but ageing and insulation and temperature trials could be made at a merely nominal expense.

But these examples do not cover the ground. I will cite two others.

In the case of a 15 kilowatt oil insulated transformer, guaranteed to develop a quarter load efficiency of 96 per cent., a full load efficiency of 97.4 per cent., and to have a regulation of 1.77 per cent., the test showed a quarter load efficiency of 94.5 per cent., a full load efficiency of 96.1 per cent., and a regulation of 1.6 per cent. The core loss of this transformer, which operates at 60 cycles, is 186.6 watts, and the specifications under which it was built require that the core loss should be about 150 watts.

It would take seven of these to give an output of 100 kilowatts—and they would cost not less than \$115 each. The seven transformers in this case would waste 3,855 kilowatt hours in a year, which represents a financial loss of \$77 in one year over and above the loss to be expected. This approximates 10 per cent. of the original cost of the transformers and is an item that cannot be neglected. If, on the other hand, this waste power could be sold at six cents per kilowatt hour, it would represent a part of the just return on the investment contemplated when the transformers were purchased, and would mean \$221 to the company.

I do not claim that the figures which I present to you cover all the items of expense that enter into the installation of 100 kilowatts—in transformers. They do not, but they do represent a phase of the question that deserves more than passing attention at a time when competition is becoming sharper and sharper.

(To be continued.)

STRAY CURRENTS.

The provision of electricity at the forthcoming Paris Exhibition will require the use of 264 gallons of water a second. This will be taken from the Seine, and before running back will be utilized in a fairy fountain. A jet of 36 yards in height is promised.—Ex.

As a proof that the heating of a wire to redness by a current of electricity partially disintegrates it, the fact may be mentioned that when air has been so freed from suspended particles that it can no longer make a mist of condensed water or harbor electrical charges, it recovers those properties if a wire is heated to redness in it for a short time.—Ex.

The resistance of the human adult body to the passage of a current from one hand to the other through the chest is about 15,000 ohms on the average. This no doubt explains why sparks from an electrical machine being due to small amounts of electricity do no harm, in spite of the enormous voltage. With the above resistance, 30,000 volts would only give a current of 2 amperes in the body.—Ex.

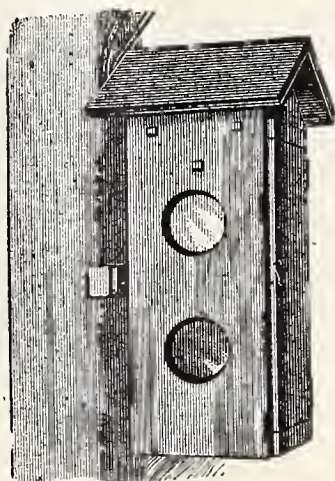
Steel for Magnets—The "American Journal of Science" gives the results of tests of a large number of magnets made of self-hardening steel, now in common use for lathe tools. The experiments show that comparatively short-seasoned magnets made of this steel have decidedly smaller induction coefficients than magnets of the same dimensions made of tool steel; the difference in the temperature coefficient is much less, but the advantage is still on the side of those made of self-hardening steel; the temperature and induction coefficients of long magnets of the two kinds of steel do not seem to be very different.—Ex.

M. Ducretet, an able French worker at the wave transmission of electricity, has produced the following effects

two signal boxes with each other. The trolley of a car on passing over the turn-out to enter the "block," strikes the corresponding automatic contact, which lights the lamps that show the green signal in the signal box at entering end, and the red signal at the other end of the section. On passing out of the "block," the trolley strikes the automatic contact on the "out" side of that turn-out, and this shuts off the current at both ends of the section.

All boxes are carefully constructed and equipped and given a thorough test before shipment.

Mr. E. D. McGowen, secretary-treasurer of the Charleston City Railway Company, of Charleston, S. C., stopped in this city while on his way to the Boston meeting of the A. S. R. A., and left an order for a number of signal boxes with the Automatic Block Signal Co. The Charleston company has used a number of the signal boxes for over a year, and Mr. McGowen states that there has not been a single rear-end collision since the boxes were installed and that all the cars have been able to run on schedule time. Rear-end collisions were an ordinary occurrence before the boxes were installed.



Automatic Electric Block Signal Box.

by means of the Hertzian undulations: He has raised a long metal wire to a red heat, started an electric motor, excited (made magnetic) a powerful electromagnet, lit up a row of incandescent lamps, and exploded a mining fuse.—Ex.

BLOCK SIGNALS FOR TROLLEY ROADS.



On trolley roads using single tracks it has been found necessary, in order to prevent the ever-increasing number of rear-end collisions, to adopt some method of signals, making travel on such roads as safe as that on steam railways using the most elaborate system of block signals. The Automatic Block Signal Co., of 136 Liberty street, New York City, manufacture an automatic electric block signal, which is giving the greatest satisfaction to trolley officials.

This signal automatically indicates at each end of a section of single track whether there is a car on that section or not, and the direction in which it is moving.

The cut shows the appearance of the box containing the signal. One of these boxes is placed on a pole near the turn-out at each end of a "block," or section of single track. The box has two lenses on each side, the two upper lenses having green glass and the two lower ones red glass, with a group of lamps between each pair of lenses. Each box has wires moving to automatic contacts on the "in" and "out" trolley wires of the turn-out near which it is placed. Two wires also connect the

HOCHHAUSEN & HALL.

We take pleasure in calling the attention of our readers to the firm of Hochhausen & Hall, 67 Liberty street, Brooklyn, N. Y., electrical engineers and contractors. Messrs. Hochhausen & Hall are both young men, with a long and varied experience in electrical construction, having been associated with the Excelsior Electric Company, of Brooklyn, for a number of years. Mr. H. T. Hochhausen is the only son of William Hochhausen, founder of the Excelsior Electric Company, the pioneer arc light company of America. Messrs. Hochhausen & Hall are fully prepared to undertake all kinds of electrical construction work, as well as repair work for dynamos, motors, etc. They make a specialty of installing petroleum engines in connection with electric light plants, giving the preference to the Mietz & Weiss engine, manufactured in Manhattan.

In connection with their repair work they make use of a very ingenious piece of machinery for winding Gramme ring armatures. This machine can be operated by one or two men, depending upon the size of the armature to be wound, and does the work more evenly than it can be done by hand. Attached to the machine there is a special winding device, which winds each section of the armature automatically and can also be set for any tension desired on the wire.

A visit to the shop of the above firm, which is located conveniently near to the bridge, showed it in full operation, indicative of the success with which Messrs. Hochhausen & Hall are meeting.

Lockport, Ill.—People's Telephone Co. has been incorporated by Allen G. Hawley, Charles B. Cheadle and Thomas A. Cheadle. Capital stock, \$14,000.

OBITUARY.**CLARENCE G. DAVENPORT.**

Clarence G. Davenport, formerly expert and agent of the General Electric Company, at 44 Broad street, who went to Porto Rico with the First Regiment Engineers, U. S. V., died of typhoid fever at Ponce on October 26th. He had been an Associate Member of the American Institute of Electrical Engineers since November 21st, 1894.

AMONG THE SOCIETIES.**NEW YORK ELECTRICAL SOCIETY.**

The following is a list of members elected at the October 27th meeting of the New York Electrical Society:

Charles E. Spiers, D. Van Nostrand Co., Murray street, New York.

H. Ward Leonard, Bronxville, N. Y.

Harold P. Davis, 918 Union street, Brooklyn, N. Y.

John C. Slack, 113 Oak street, Greenpoint, Brooklyn, N. Y.

James H. Mason, 152 E. 23d street, New York.

W. F. D. Crane, Reynolds Terrace, Orange, N. J.

Dr. F. S. Kolle, 273 Prospect avenue, Brooklyn, N. Y.

William A. Brown, Jr., Assistant Chief Elec. Eng. Penna. R. R., Broad Street Station, Philadelphia, Pa.

Frank D. Sweeten, junior member Vallee Bros. & Co., 625 Arch street, Philadelphia, Pa.

William A. Brown, Chief Elec. Eng. Penna. R. R., Broad Street Station, Philadelphia, Pa.

Charles Shirley, N. Y. Mgr. Mass. Office Boston Postal Tel. Cable Co., 253 Broadway, New York.

Albert Eckert Chandler, Postal Tel. Cable Co., 253 Broadway, New York.

Edward J. Powers, 45 Cedar street, New York.

B. F. Hamilton, 510 W. 23d street, New York.

Mortimer Lewis Newman, E. E., 107 E. 90th street, New York.

Lawrence Strauss, 120 E. 117th street, New York.

G. Herbert Condict, Chief Eng. Electric Vehicle Co., 1630 Broadway, New York.

James Appleton, Chief Eng. Construction Dept. Elec. Storage Battery Co., Drexel Bldg., Philadelphia, Pa.

Dr. Jean F. Chauveau, 216 W. 103d street, New York.

George N. Moore, Asst. Supt. Edison Elec. Illum. Co., 53d Street Station, New York.

James J. McKenna, Maintenance Co., St. Paul Bldg., New York.

H. B. Kirkland, 120 Liberty street, New York.

Adolph L. Goldschmidt, 425 E. 50th street, New York.

John J. Breslawsky, Leonard & McCoy, 118 Liberty street, New York; 1735 Madison avenue, New York.

John T. Hunt, Zimdars & Hunt, 127 5th avenue, New York.

Wm. M. Stewart, N. Y. Telephone Co., 15 Dey street, New York.

Horace Dowie, 363 Jefferson avenue, Brooklyn, N. Y.

Hiram D. Torrie, Jr., Riverside, N. J.

Henry M. Jackson, Pres. Peoples L. & P. Co., Newark, N. J.

Dudley Farrand, Peoples L. & P. Co., Newark, N. J.

NEW INCORPORATIONS.

Bonham, Tex.—The Bonham Electric Light & Power Co. has been incorporated by J. F. Heledge, J. B. Russell, J. N. Rainey and E. F. White. Capital stock, \$25,000.

Montgomery, W. Va.—The Kanawha Electric Co. has been incorporated by J. W. Straughan, W. S. Montgomery, Jacob Sigal, E. W. McCormick and M. S. McCormick. Capital stock, \$5,000.

St. Louis, Mo.—The Northwestern Electric Heat & Power Co. has been incorporated by F. W. Bles, John F. Schafer and Charles E. Roehl. Capital stock, \$30,000.

Indianapolis, Ind.—Electric Therapeutic Manufacturing Co. has been incorporated, with a capital stock of \$5,000.

POSSIBLE INSTALLATIONS.

Asheboro, N. C.—John T. Moffit may give information concerning establishment of an electric lighting plant.

Greensboro, N. C.—B. S. Johnson and others, of Baltimore, Md., contemplate installing an incandescent electric lighting plant in Greensboro.

Miami, Fla.—J. A. McDonald is interested in the establishment of an electric light plant.

Monroe, La.—A. A. Forsythe, Mayor, may be addressed for information concerning proposed establishment of an electric light plant.

Mountain Lake Park, Md.—The Mountain Lake Park Association contemplates the construction of an electric light plant.

Yazoo City, Miss.—L. G. Montgomery may give information concerning contemplated construction of electric lighting plant.

Salisbury, N. C.—F. E. Boardman has been granted franchise for constructing an electric light plant.

Winchester, Va.—The Winchester Gas & Electric Light Co. is considering the establishment of an arc plant.

INVENTORS...**WHAT IS WRONG**

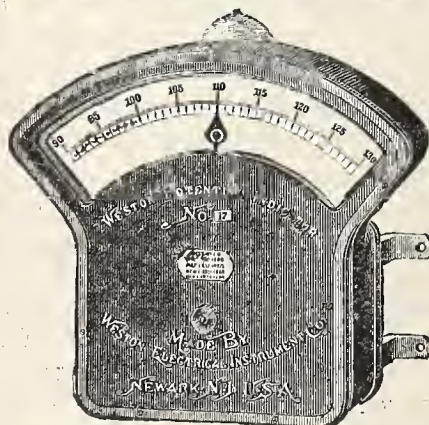
With your invention? Why can't you get capital? We will tell you. You require endorsement by competent experts; we have them. If your invention has merit, our endorsement will enable you to get capital. Try us. Fees moderate. Correspondence solicited.

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WESTON

STANDARD
ILLUMINATED DIAL
STATION
INSTRUMENTS.

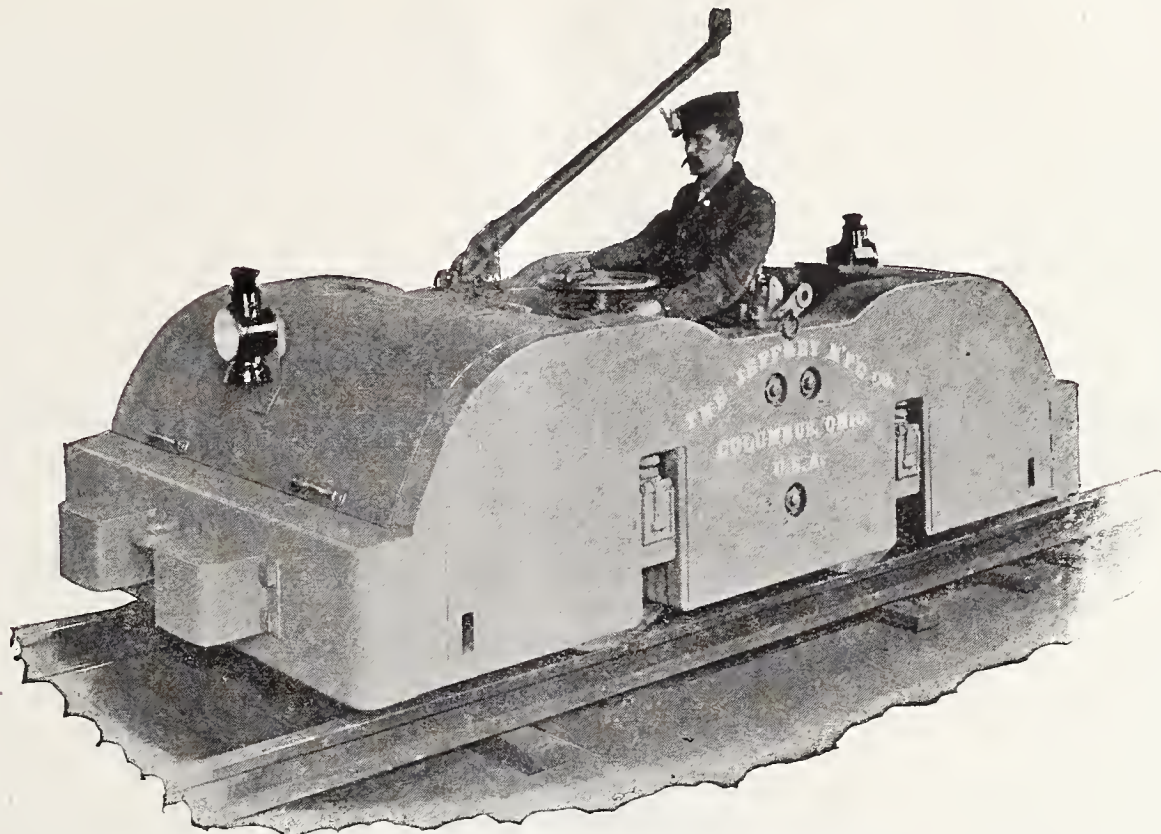


THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

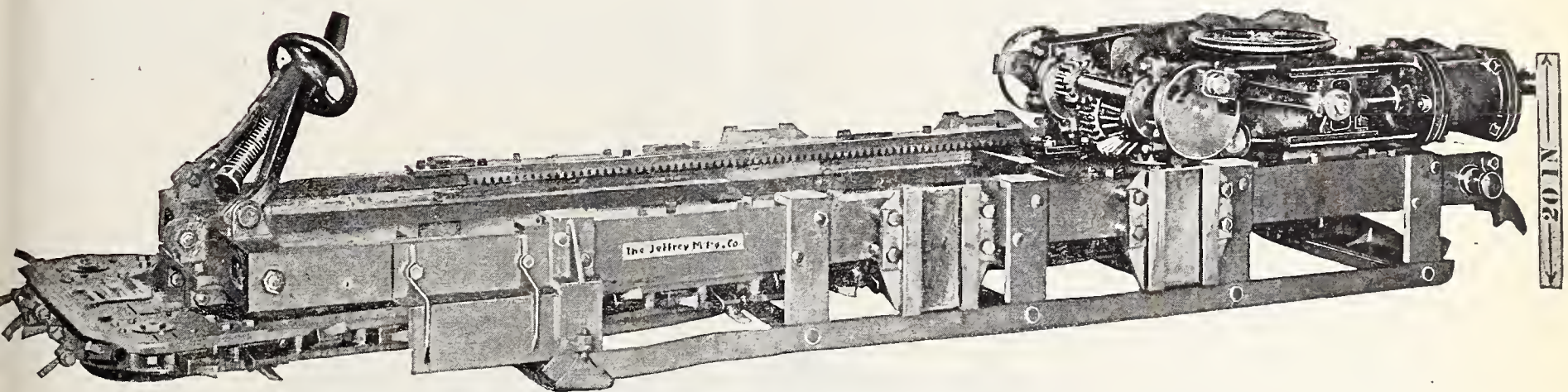
WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

ELECTRIC MINING.



Jeffrey Electric Locomotive. Man in Middle.



Jeffrey Air Chain Coal Cutting Machine.

JEFFREY ELECTRIC COAL-MINING MACHINERY

Those interested in coal-mining machinery will be interested to know that the Jeffrey Manufacturing Company, Columbus, Ohio, have recently placed on the market an improved electric chain coal-cutting machine, an illustration of which is given in this issue.

The machine as shown is constructed on lines similar to the ones previously built by this company, and is the outcome of experience gained during twenty (20) years of actual operation. It contains the necessary qualifications to make it superior to all others that have preceded it.

This company, being the pioneers in the manufacture of coal-mining machinery, have had the advantage of a great many years' experience in the construction of such machines. With this experience and a well-equipped fac-

tory they have been able to keep abreast of the times and to maintain their position as leaders.

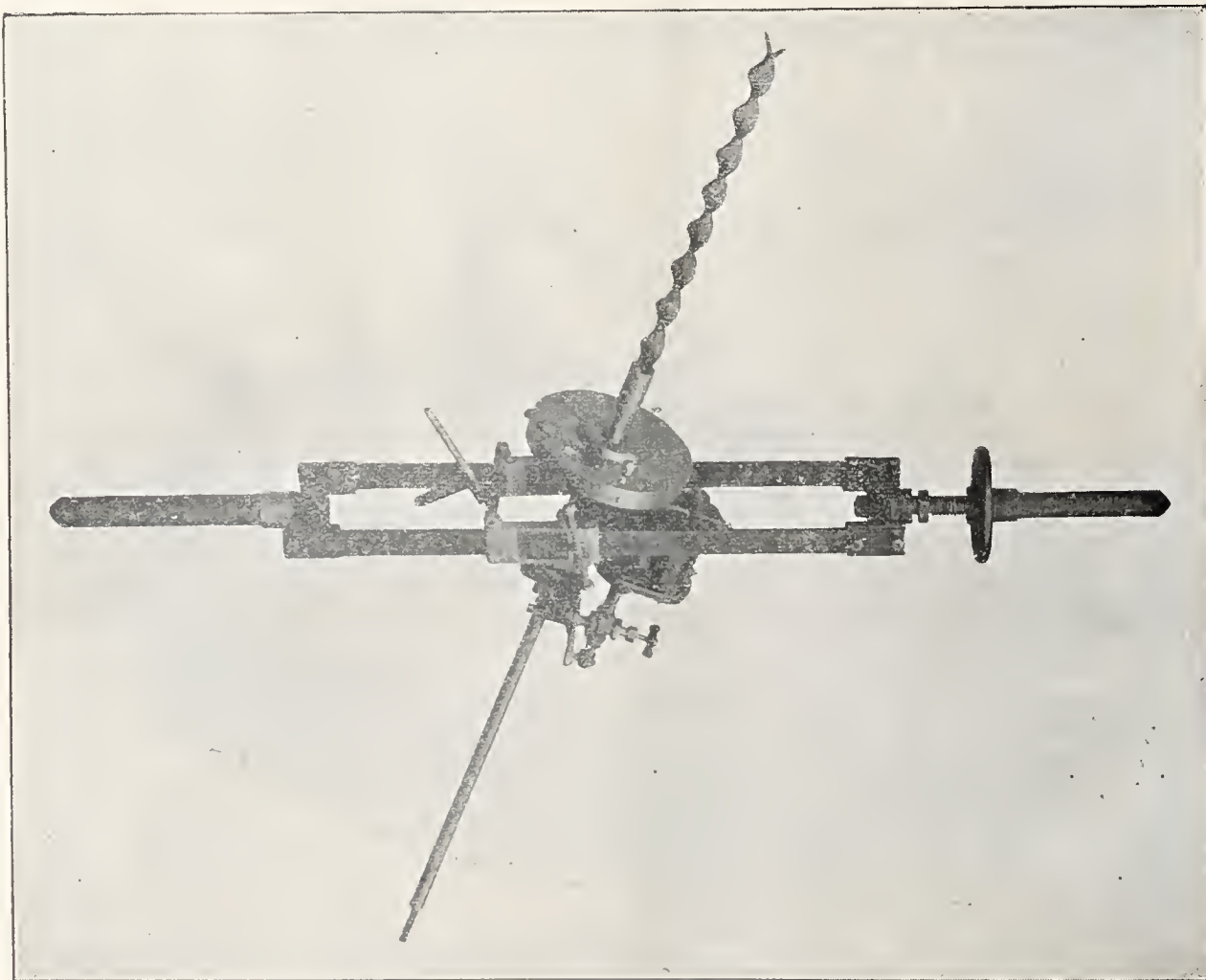
The most marked improvement in the machine is found in the motor. This is known as the "M M 17 A" motor and is of the multipolar iron-clad armature type. It is built to perform the most severe duties to which a coal-cutting machine is subjected and is calculated to operate with minimum repairs, together with high efficiency. The frame is of cast steel; the magnetic circuit being of ample capacity to allow of no undue heating.

The armature is of the iron-clad type; that is, the wires are embedded in the cores of the armature, the outside of the armature having the appearance of a solid band; this gives protection against injury while moving

from place to place or from any unusual rough treatment it may receive; it is calculated to run continuously. The armature shaft has large and ample bearings, and the longest runs have failed to develop over-heating.

All pinions, worms and worm wheels are keyed on to their respective shafts. In the early machines these were forged onto the shaft and then cut; this was done in order to secure minimum space. The trouble arising from

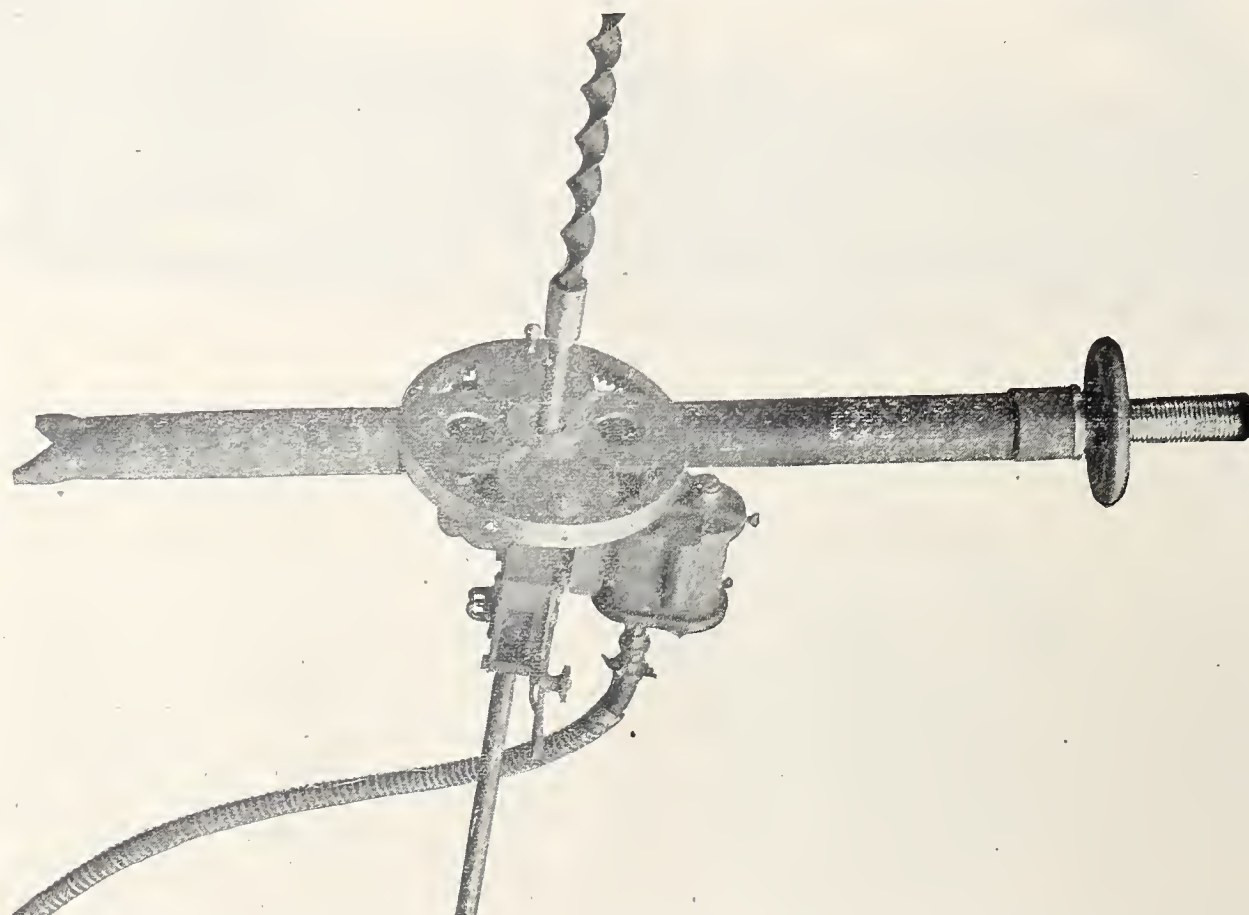
Air Power Drill.



The filled coils are of ample capacity to carry their proportion of the current at the rated capacity without undue heating, and develop an extremely low temperature after a continuous run of several hours on full load.

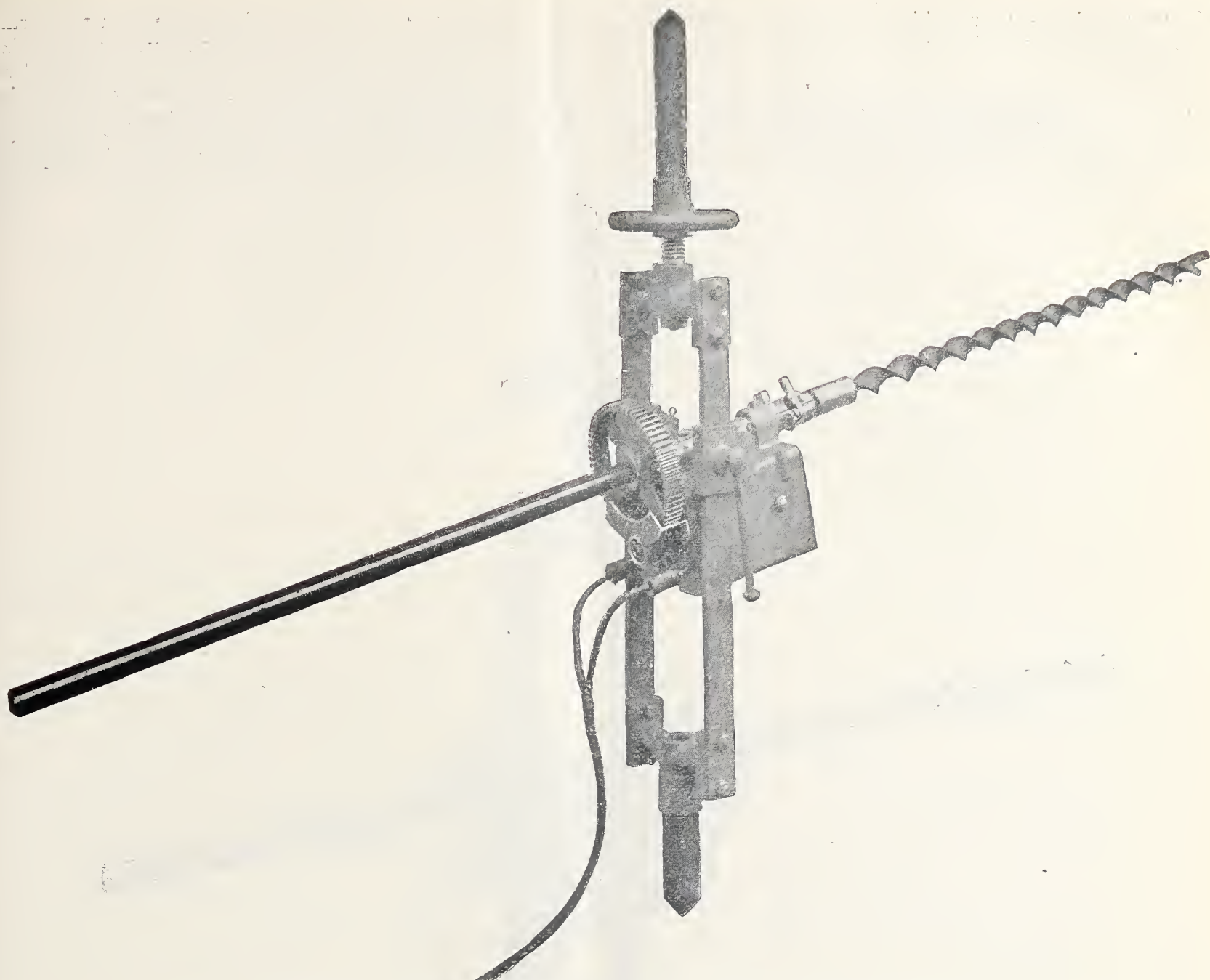
this source and the great expense attached to replacing them (it being necessary to replace shaft and gears when gear became disfigured) was so great that it was finally considered to be impracticable, and the change was made

Jeffrey Giant Air Drill, Single Post. For great variations in height.

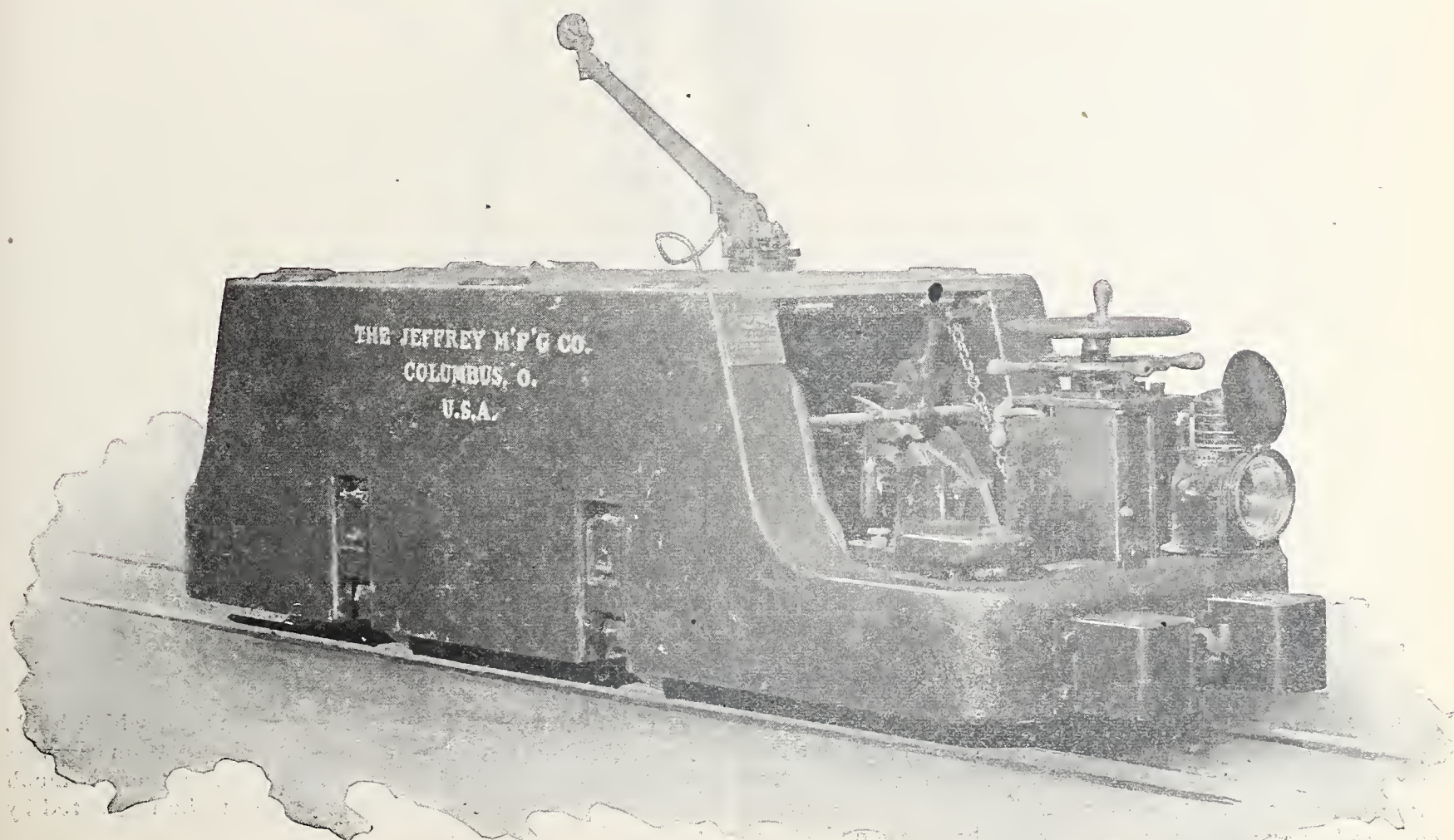


There is absolutely no sparking at the commutator, and the rise of temperature at this point is exceedingly small. The commutator is made of the best quality hard-drawn copper and is of ample capacity.

to separate shafts and separate pinions. The shafts are forged steel. The pinions are keyed to the shaft. By doing this the safety was increased and the expense decreased. The construction has been carried out for sev-



Jeffrey A 1 1-2 Electric Drill, Double Post. For use in bituminous fields.

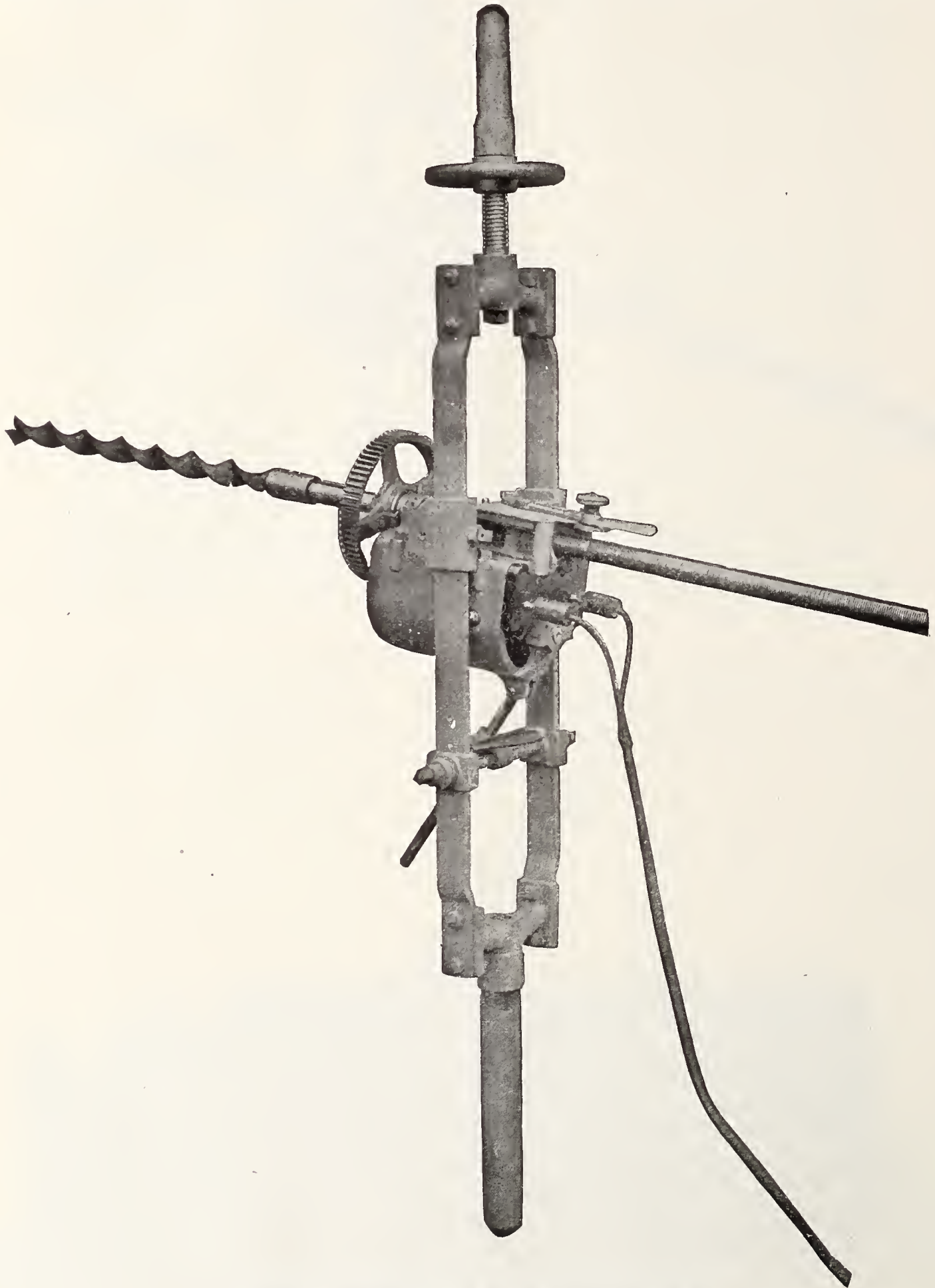


Jeffrey Electric Locomotive. Man on End.

eral years and has thoroughly demonstrated its value. All the bearings are of bronze, no babbitt being used in any case.

The chain carrying the cutters is made up of cast steel solid links coupled together with drop-forged straps; these strap links having lugs at each end which provide bearings for the cutter links, the straps being held to-

been widened to cut six (6) inches more than the former machine, making the total width of the cut forty-four (44) inches, with a kerf of four (4) inches. The cutter head is bolted together and can be easily and readily taken apart. At each corner of the cutter head is an idler on which the cutting chain runs. To provide for an ample supply of oil to the bearings of the idlers a double bear-



Jeffrey A 2 Electric Drill. For use in anthracite fields.

gether by means of a rolled steel rivet, which receives no strain whatever. By this construction the chain is easily taken apart and can be replaced in minimum time. The bits used are straight, with a slight hook at the cutting end, and are so shaped that they can be sharpened a number of times, allowing about seventy-five (75) per cent. of the steel in each bit to be used.

Another marked change is in the cutter head; this has

ing is used, which allows space for packing, which holds the oil, thus providing a constant lubrication at this point. This is of very great importance, as there is much strain at this point, which is most apt to be neglected by the machine operator.

These machines are built to under-cut 5 ft., 6 ft. and 7 ft., the width of each cut being forty-four (44) inches, with a kerf of about four (4) inches.

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INVENTION DEPENDENT UPON SCIENTIFIC KNOWLEDGE.

Intuitive invention is the outcome of a mind peculiarly gifted. It is an inherent power from which springs a great idea, the crystallization of which may leave it impressed upon the world for untold ages. The dependence of inventive power upon scientific knowledge is largely admitted by all men of scientific eminence, yet, strange to say, originality dies in such, and invention pure and simple is left to those of a lesser education and inferior scientific knowledge. A mind possessing originality is quick to grasp at a suggestion and develop it so that it becomes of direct importance and practical utility. In the field of applied science, particularly that of electrical engineering, the power of invention is largely dependent upon a good scientific training. The stepping stones of progress in this particular field are the dynamo, telegraph, telephone, arc and incandescent lamp, primary battery, etc.

All of these have been more or less originated and in part perfected by men of considerable scientific ability. Combinations have been effected from which spring systems of electric lighting of great commercial importance. Viewed as a whole, these systems represent a higher plane of intellectual development, the application of reason based upon existing elements. This opens up a new phase of invention, which, in the field of applied electricity, is more apt to be met with. If it is the invention of a new combination it certainly merits as much approbation in its way as a simpler, better known, though possibly not more valuable departure. It becomes more evident from a review of such cases that invention of a high order may be the product of certain minds only after having passed through a course of severe scientific disci-

pline. On the other hand, the inventive faculty is often discovered in those whose illiteracy and lack of intellectuality is very marked indeed.

As an example of inventive power due to the possession of high intellectual attainments combined with rare scientific ability we cite the case of Nikola Tesla; in opposition to him, Thomas A. Edison, in whom the inventive faculty has been strongly developed, but whose mental horizon is not so far-spread and wide-reaching as that of his younger confrere. Edison received little or no early training. He began life with severe trials confronting him, whereas Tesla had better opportunities and hence belongs to that class of inventors whose most notable successes were the fruits of a thorough scientific training. Thus by comparison side by side may be ranged inventors of repute, and it would be impossible to state among those best known which class preponderates, the inventor possessing many accomplishments or the one to whom arduous toil has been the only means of achieving success. It may be stated, however, that the civilized world is beginning to appreciate the fact that a higher education and higher training aids the mind to an extraordinary degree in many of the occupations of life. It quickens the mind to receive suggestions and cultivates in it the habit of thinking rationally.

In the "Journal of the Franklin Institute" may be found an article entitled "Science in the Public Schools," from which we quote: "Within less than a generation the scientific leaven has been working rapidly among educational authorities. The high school of today is equipped with apparatus and laboratories such as the best technical institute of thirty years ago did not possess. Facts unknown to the investigators of our childhood, discoveries unmade until a recent period, observations of a later date, help a lad who has a scientific turn of mind to develop his faculties. This improvement has in no small degree been brought about by the actions of scientific institutions."

To quote further: "Men who were fond of electricity or who liked to know what was being done at the great iron works or who wished to know something of the latest achievements in engineering could find congenial spirits at the Franklin Institute. Many a boy sent to its drawing school grew interested in the long shelves of books and in the apparatus which stimulated a desire to know more and more of the achievements of human industry. To consult a dozen volumes of Patent Office Reports or even to see half a hundred industrial publications is an experience to him who passes through it for the first time."

Scientific societies, as may be seen from the foregoing, exercise a great influence over the community and certainly assist in a large degree in hurrying along the tide of invention.

One of the great advantages of an American education is its acknowledgement of the commercial importance of scientific application and its readiness to make use of them on all occasions. In no section of the earth's surface is invention so greatly encouraged as in the United States. Many high-class inventions have appeared and an enormous number of small ones from New England. But to-day, as well as in the past, the greatest of them all have been the simplest ones, and their further elaboration has been entirely due to a better comprehension of the principle of operation, which, in comparison with the original thought, is of secondary importance.

Dallas, Tex.—The Sutton-Steele Electrical Co. has been incorporated by Walter L. Steele, Henry M. Sutton, Emmett A. Ellis and J. L. Sale. Capital stock, \$20,000.

Worcester, Mass.—The People's Telephone and Telegraph Co. has been incorporated with Israel L. Currier, president; Fred W. White, treasurer. Capital stock, \$150,000.

All machinery built by this company is made from templates, and in case of accidents by fall of roof or other unusual circumstances any parts can be replaced without delay.

Considering the machine as a whole and in detail, it is an excellent piece of machinery, and one which will stand the inspection of the most critical mechanic.

The self-propelling truck, which is also illustrated with machine (both off and on), is a valuable addition to the machine where heavy grades are to be encountered and where pitching veins occur. With this truck it is possible to convert the machine into a locomotive and cause it to propel itself from point to point. By means of a reversing switch on the motor it is possible to run it in either direction. It will be observed that the motion is imparted to the truck wheels by means of a chain and sprocket. This method of propulsion is being used in mines pitching from 12 to 15 degrees. The truck itself is entirely of iron and is strongly and compactly built.

Since this machine has been in operation records of three hundred (300) lineal feet face, 5 ft. and 6 ft. deep, have been made in ten hours. The reduction in cost of repairs and the increased efficiency recommend it to the use of operators in need of such machinery.

The Jeffrey Manufacturing Company have always had the reputation of producing nothing but high-grade work, and in considering the bringing out of the machine (here described and illustrated) the question arose as to the wisdom of placing on the market a machine of cheaper construction, but realizing that by reducing the standard of construction and workmanship the life and efficiency of the machine would be decreased, they wisely made the decision not to lower the standard of excellence of their construction.

The advantages of an electric locomotive for mining purposes have been admitted by the largest mining establishments in the world. The high efficiency, cleanliness, convenience and freedom from risk by the use of electricity has made it indispensable in certain mining operations. The simple adaptation of mining machinery operated electrically to mining purposes has not in any way required a more extensive knowledge from the mining engineer. But in the general operation of mines the saving in different directions and the great convenience the use of electricity entails has made it a strongly competing factor with compressed air, steam, etc.

The electric mine locomotive made by the Jeffrey Manufacturing Company, built to carry, as shown in illustrations, a man in middle or at the end, is of unsurpassed design. A review of its good qualities would show that it is built in accordance with the requirements of practice. It is necessary to make the locomotives as compact and low as possible, to make them narrow, to obtain great hauling power with as high a speed as possible and to make them dust-proof and water-tight. The Jeffrey electric locomotive possesses all these features and represents all that a careful study of practical mining can give in the way of suggestions. The definiteness of action and flexibility of control exercised by the operator of an electric locomotive, as well as the freedom from fumes, heat, etc., certainly point strongly in favor of its general application.

The electric drills used mainly for coal mining manufactured by the Jeffrey people are preëminently successful on account of their simplicity and convenience. In the illustrations may be found types of the double post for use in the bituminous beds and the A2 for use in anthracite fields. These drills, as well as others that they manufacture, operated by air pressure have met with great success wherever installed. The types mentioned are auger drills. When electrically operated they merely consist of a drill driven by an electric motor. It is set into the vein and tilted to any angle to which it may be fixed by means of a supporting device.

Many of the largest mines in this country, to which

the introduction of electricity has meant a direct increase in profit and a rise in the value of their stock, find that auger drills, locomotives, pumps, coal cutters, etc., electrically driven, are so superior to the more mechanical forms that a trial of them has usually resulted in their ultimate and complete adoption.

The drills referred to above are driven by a motor of the multipolar type. They are completely encased, with terminals accessible, armature and field coils thoroughly insulated and parts interchangeable. The standard electric drill does not weigh more than one hundred and fifty pounds complete. The angular range is sixty degrees from the horizontal and ninety degrees from the vertical. The feed bar is five and one-half inches in length. On one end of this is a socket to receive the auger. The feed nut is arranged in front of the drill and is supported by a drill. The nut is held in position by a collar, about which passes a steel spring friction band, which can be adjusted to allow the nut to turn with the auger at any pressure desired. This insures a release of strain on the drill when the auger strikes any hard substance, such as sulphur, hard slate or any other foreign material. This automatic stoppage of the feed prolongs the life of the drill and allows the machine to work under a uniform strain.

The economy of drilling as described above is such that from three to six hundred linear feet per day are bored. A man and a boy are all the aid required. The electric locomotives vary from ten to eighty horse power. Their minimum gauge is eighteen inches.

For further particulars correspond with the above concern at Columbus, O.

MISCELLANEOUS SCIENCE.

THE POWER NECESSARY TO MOVE THE EARTH.

La Nature, Paris.

Statisticians sometimes have queer ideas. One of them has amused himself by calculating how much energy, water and coal it would take to move the earth a foot, supposing that it was subjected throughout its mass to a force equivalent to terrestrial gravitation. This is a gratuitous supposition, for in spite of its enormous mass the earth weighs nothing, and it is only by piling up hypotheses that we can get an idea of Archimedes's famous lever. Starting with the fact that the earth's mass is about 6,100 million-million-million tons, our statistician calculates that we should require 70,000 million years for a 10,000 horse-power engine to move our globe a foot. The boiler that should feed this engine would vaporize a quantity of water that would cover the whole face of the globe with a layer three hundred feet deep. The vaporization of this water would require 4,000 million-million tons of coal. This coal, carried in cars holding ten tons each, and having a total length of thirty feet, would require four hundred million-million cars, which would reach 80,000,000 times around the earth. This train, moving at the rate of forty miles an hour, would take more than 5,000,000 years to traverse its own length. It would require for storage a shed that would cover a thousand times the area of Europe. If we realize that this fantastically huge amount of energy is as nothing at all compared with what the earth possesses in virtue of its rotation about its axis, its revolution about the sun, and its translation in space with the solar system, of which the earth is but an infinitesimal part and which is itself but an infinitesimal part of the universe, we may get some idea of the importance of man in the universe, and estimate his incommensurable pride at its just value.

Milledgeville, Ga.—J. G. Croley may be addressed concerning establishment of electric light plant.

LIGHTING.

PORTABLE ELECTRIC SAFETY LAMP.

There has recently been devised a portable electric safety lamp for use in special cases when an open flame or even one safeguarded, as in the miner's lamp, would

power, and is set in a small white enameled parabolic reflector, provided with a stick-pin to allow it to be attached to the hat or any part of the clothing. The light is strong enough to allow ordinary printed matter to be read at a distance of 100 feet from the lamp.

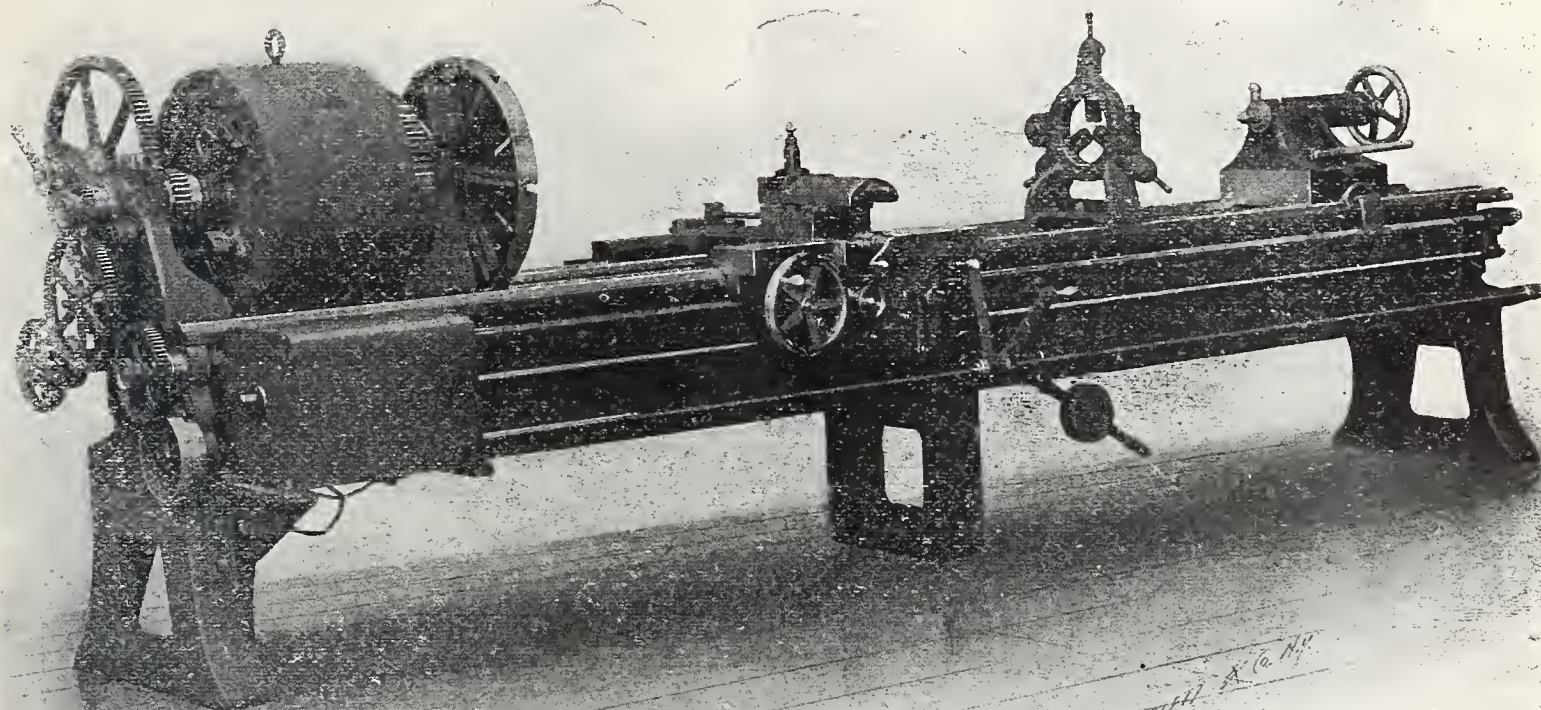
The combination is manufactured by Elmer E. McIntyre, of Pittsburg, and has been found very useful by gas inspectors in reading meters in dark cellars; by re-



Miners' Portable Electric Safety Lamp in use.

prove dangerous. The combination consists of a dry battery arranged to be carried in a holder at the belt, or in the pocket. The battery is controlled by a small rheostat, maintaining an even supply of current to the lamp and allowing it to burn with the same brilliancy during the life of the battery. Changing an exhausted for a new battery involves no electrical knowledge. The electric lamp, connected to the battery by a flexible cord,

pair men exploring cellars and trenches for gas leaks and defective pipe connections or examining gaseous sewers; by miners and mine inspectors in gaseous mines, where the risk of explosion even from the miner's lamp is ever present; by watchmen in powder mills and warehouses storing inflammable oils and essences, or by workmen repairing oil and gas tanks or examining the riveting inside steam boilers. This lamp is especially valuable as it



Bullock Type E Slow-speed Motor Built in the Headstock of a 22-inch Engine Lathe.

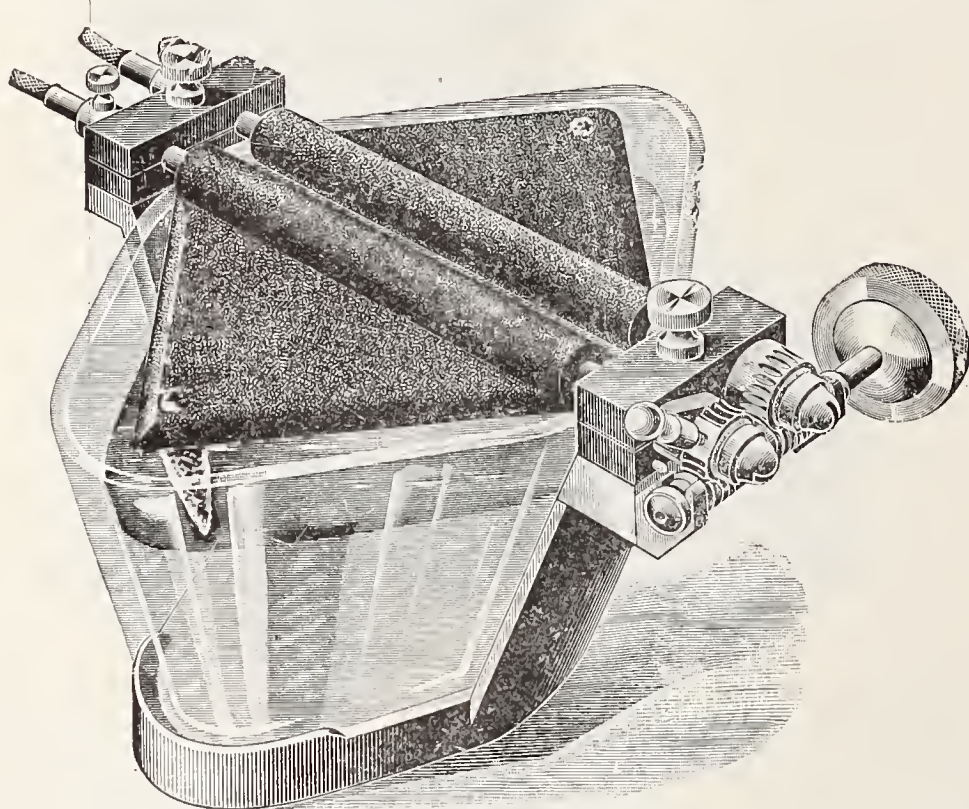
is the miners' lamp manufactured at the Edison Lamp Works of the General Electric Co. It is of six-candle

leaves the hands free, and its weight is so small—about two pounds—as to be hardly noticeable.

ELECTRIC LIGHT AND POWER.**BULLOCK POWER MOTORS.**

There is a great change taking place in many of our modern factories and machine shops. It was only a few years ago that a shop that was lighted by electricity was considered to have taken a great step to the front. The use of electricity was recognized to be a saving, but it was only considered as a means of saving in the expense and convenience of lighting. Now the great use of electricity in factories is its employment as a driving power for all classes of machinery. The old method of drive,

panying cut shows one of their motors direct-connected to a Niles Tool Works Lathe. This is one of many of these combinations which have been sent to factories in various parts of this country and England. The Bullock Company are at present putting motors in the headstock of three more of these lathes. Unless the lathe is 22 inches in swing or larger, it is not practical to put the motor directly in the headstock of the lathe, as the motor will be too large for the ordinary size of headstock. In case of 18-inch swing and under, the Bullock people have another arrangement. The lathe is taken as an example of machine tools driven by direct-connected motors, but the same has been done with other tools. The Bullock



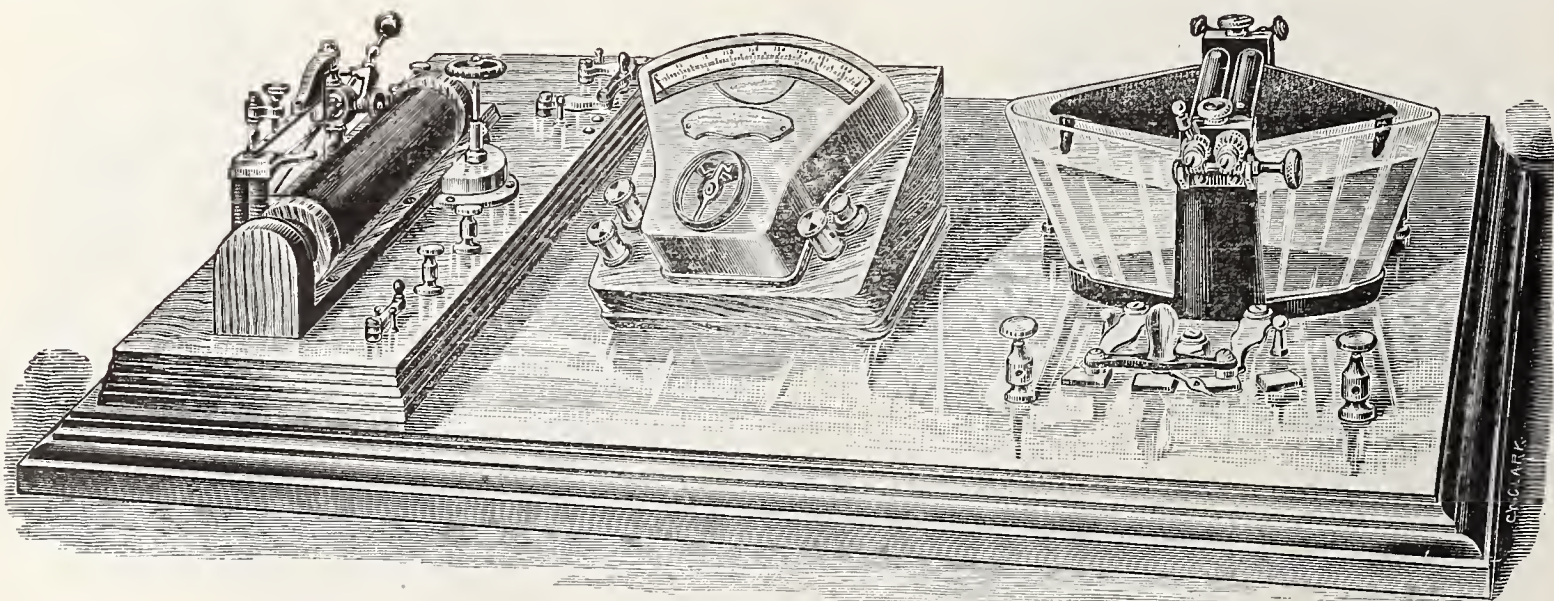
The Law-Bailey Current Controller.

requiring long lines of shafting and innumerable belts, is gradually being supplanted by the use of wires and a few motors placed either on a counter-shaft or directly attached to the driving shaft of the machines. This advance of electricity in the machine shops and factories is still in its infancy, though even at present a large percentage of those shops which have been built in the

Electric Manufacturing Co. have successfully put motors on almost every style of machine tool.

ELECTRO-THERAPEUTICS.**MODERN ELECTRO-MEDICAL OUTFITS.**

The advance in the field of electro-medical appliances



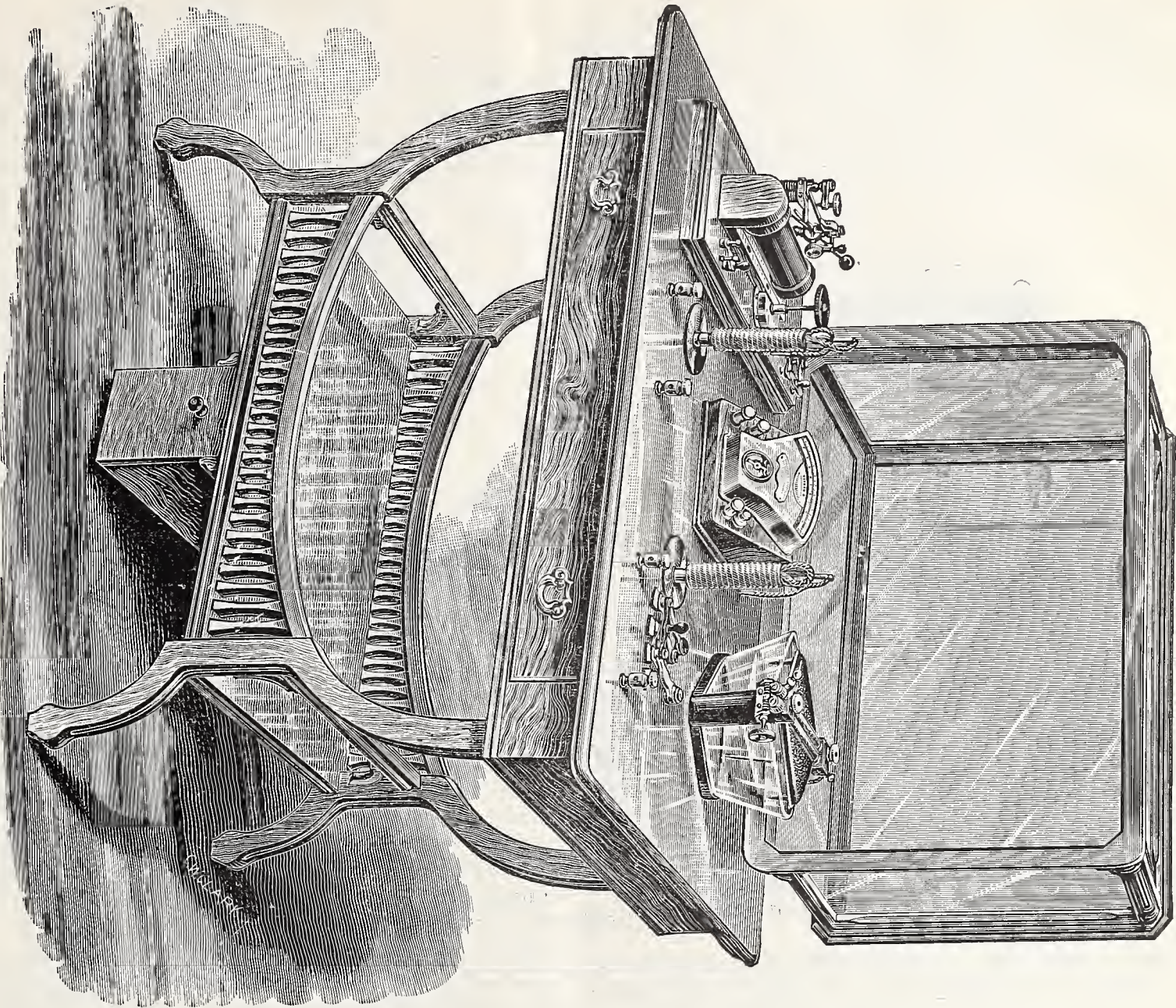
The Law Medical Shelf Outfit.

last few years, or have been remodeled in any way, have been equipped with electricity. Within ten years it is safe to say that every factory or machine shop, which is not considered behind the times, will be using electricity for driving its tools.

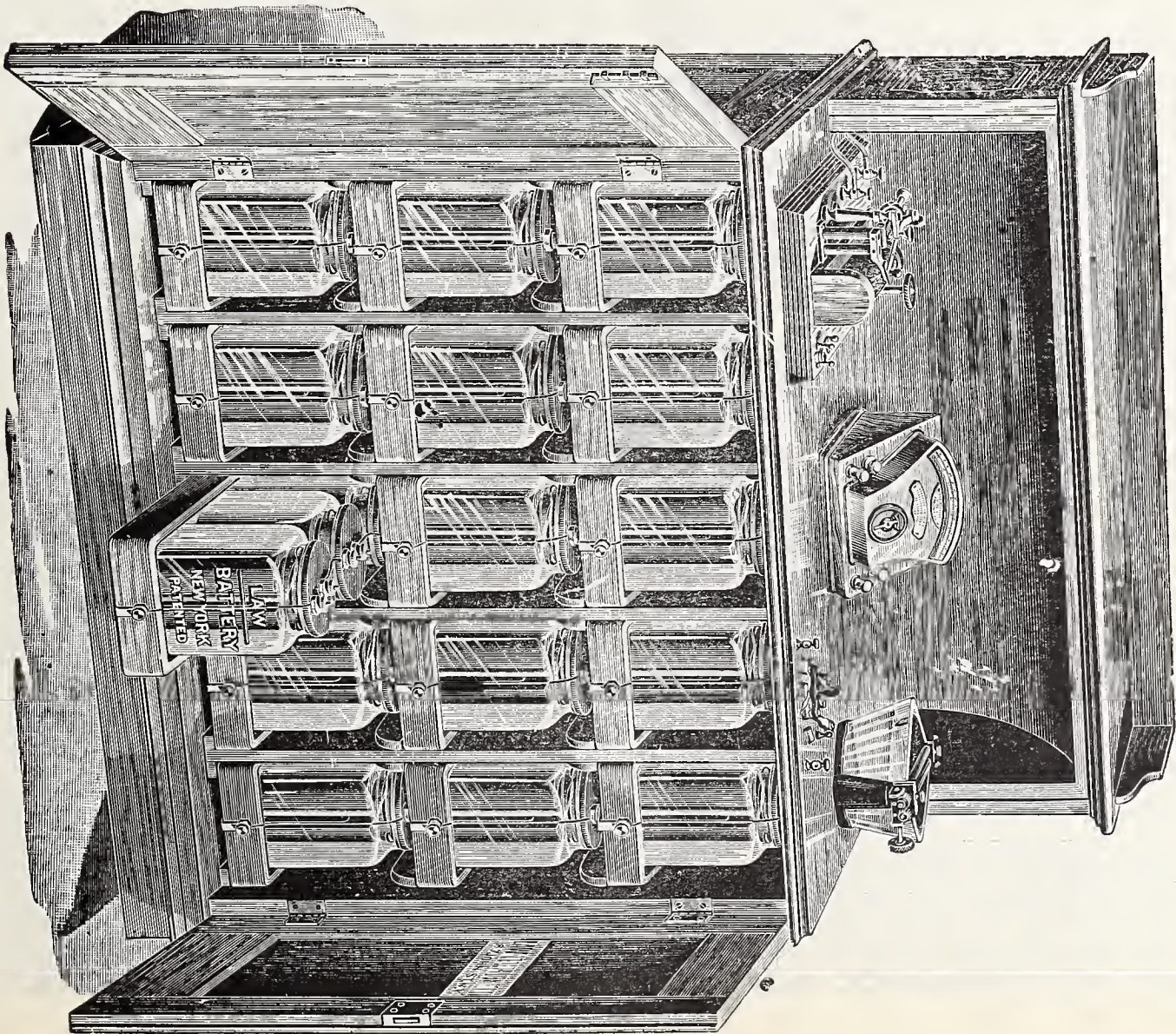
The Bullock Electric Manufacturing Co. were one of the pioneers in this branch of the use of electricity and they have met with well merited success. The accom-

panying cut shows one of their motors direct-connected to a Niles Tool Works Lathe. This is one of many of these combinations which have been sent to factories in various parts of this country and England. The Bullock Company are at present putting motors in the headstock of three more of these lathes. Unless the lathe is 22 inches in swing or larger, it is not practical to put the motor directly in the headstock of the lathe, as the motor will be too large for the ordinary size of headstock. In case of 18-inch swing and under, the Bullock people have another arrangement. The lathe is taken as an example of machine tools driven by direct-connected motors, but the same has been done with other tools. The Bullock

has developed to such an extent that both battery man and instrument maker have been forced to supply the best that human ingenuity is capable of producing. After years of careful study preparatory to placing in the electro-therapeutical field instruments the most efficient in quality and the most compact in structure, we are pleased to call the attention of the medical profession to the instruments herein enumerated, described and il-

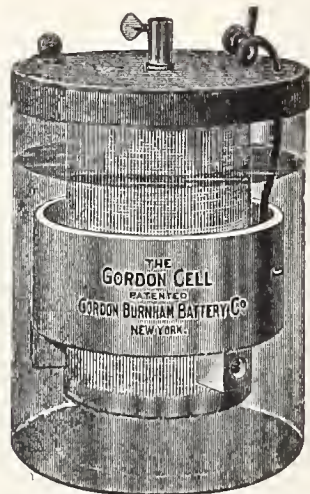


The Law Medical Table On It.



The Law Medical Cabinet On It.

lustrated. This is the celebrated Law cabinet. It is 44 in. high, 23 inches wide, and 22 inches deep, and can be constructed in antique oak, mahogany or walnut. It is equipped with fifteen drawers, capable of holding four cells each. In case a longer-life battery with more volume is desired, the Gordon Battery Co. can substitute the Gordon primary cells, No. 2 size, for the Law cells.



Although they advocate, when means permit, the purchase of the cabinet in preference to the table, they are, however, pleased to call attention to the merits of this table outfit. It is 36 inches long, 22 inches wide, and 38 inches high, and is finished the same all over. It makes a splendid disposition of the instruments, and when the top is down and the doors closed it is in appearance like a desk. It can be equipped with either the Law cells or the Gordon primary cells, the latter reducing the cost of operation and maintenance, in a period of years, about 30 per cent.

The shelf outfit affords a ready means for disposing of the instruments at a small outlay, the cells, of course, requiring a separate and convenient place of deposit. It is made of antique oak or other hard wood, finely polished and finished, being 24 inches x 15½ inches in size, and is designed to rest on brackets against the wall or set upon a table. Either Law cells or Gordon primary cells can be furnished with this shelf outfit.

Although simple in appearance, the new Law-Bailey current controller is the result of six years' experiment with the old Bailey controller and six years' experiment with the new Bailey controller, and as a result it stands upon the market today without a peer. It is a perfect supplantation of the switchboard or cell selector as a means of modifying the current, turning it off and on steadily and gradually, thus preventing disagreeable and injurious shocks in all cases in which these regulations are essential.

It is an instrument commendable for its simplicity, certainty of current graduation and equal distribution of wear among the cells.

The Gordon Battery Company have their offices at 594 Broadway, New York City, and factory at Cranford, N. J. The cells they manufacture possess to a high degree the following qualities: low internal resistance, uniformity of current, high electromotive force, non-corrodable connections and long life. The cell is clean and odorless, and the ampere hours are not affected by changes of temperature. The Gordon battery has found a wide field of application, not only among physicians, but with trunk railway corporations, electric gas-lighting concerns, telegraphic purposes and in the amateur's hands.

A patent has been granted to Pierre O. Kielholtz and James F. Heyward, of Baltimore, for an invention to locate defects in rail-bonding for return electric circuits. Mr. Kielholtz is the managing electrician of the City and Suburban Railway, and Mr. Heyward is the general manager of the company.—Ex.

STRAY CURRENTS.

The use of electric power generated by a turbine wheel for farm purposes is quite well established in some parts of Germany and contains great possibilities for the future. The turbine wheel would not always be practicable, but the generation and distribution of electric power



on a large scale is all but a certainty. When it comes the farmer may be the greatest beneficiary of us all.—Ex.

The cyclist can now take a course of electric treatment on his wheel. A new handle-bar has been brought out which has metallic grips connected with a small generator mounted on one of the wheels. In another form of the same device shoes are provided with contact plates. If the force of the current depends upon the speed the wheels are rotating, this may be a satisfactory device to discourage scorching.—Ex.

It is understood, says an Indian newspaper, that the proposed scheme to obtain water power from the Sutlej to be transmitted electrically up the hill for use at the spring water pumping stations instead of steam, and also for electric lighting, is considered possible, but financially impracticable at present or in the near future.—Ex.

The passage through the St. Gothard tunnel is described by a recently returned traveller as having been something appalling during the recent hot season. With smoking locomotives burning briquette coal, the journey of 9¼ miles, which occupies about 20 minutes, is almost unbearable. The informant states that there is not far from the tunnel mouth a stream of fair size, which falls about 1,100 feet in a course of four miles by road, so that the water could easily be piped to Goeschenen, a distance of 2¾ miles by road from the Devil's Bridge, nearly 1,000 feet above Goeschenen, and utilized on Pelton wheels to work the tunnel by electricity.—Ex.

Mr. J. F. Kelly, of the Stanley Electric Mfg. Co., Pittsfield, Mass., has patented a device for preventing the leaking of lines of force from a dynamo or alternator into the engine coupled to it. The patent illustration shows an inductor type of alternator with a single coil. In this case the shaft is magnetized, and leakage lines tend to pass through the working parts up to the cylinders and bed plate, and hence back to the alternator frame. To prevent this Mr. Kelly proposes to use a second coil round the shaft near the coupling, and to so proportion the ampere turns in it that the magnetomotive force of the large coil is neutralized.—Ex.

North Tonawanda, N. Y.—Tonawanda Cataract Power Company has been incorporated by Edward D. Adams, Francis Lynde Stetson, Edward A. Weekes, William B. Rankine, Charles Sweet, L. A. Groat and Delancy Rankine; to supply light, heat and power. Capital stock, \$100,000.

Little Rock, Ark.—South M'Allister Electric Light Co. has been incorporated with L. G. Graham, president. Capital stock, \$25,000.

Among the Societies

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 128th Meeting of the Institute was held at 12 West 31st street, on Wednesday, October 26th, President Kennelly in the chair. A paper was read by Mr. A. A. Knudson on "An Electrical Survey in the Borough of Manhattan, New York City." The discussion was opened with a communication from William Maver, Jr., continued by Townsend Wolcott, Jesse M. Smith and others.

The president announced that a Committee on Co-operative Research had been appointed in accordance with instructions from Council. The committee consists of Dr. A. E. Kennelly, chairman; Prof. W. A. Anthony, Dr. F. B. Crocker, Dr. C. T. Hutchinson, Dr. Samuel Sheldon, Charles P. Steinmetz and Prof. E. Thomson. The purpose is to formulate a system of experimental research, by submitting to various colleges and universities various problems which are of practical importance. The committee starts off with a list of sixteen subjects and will expect members to send in others which may occur to them in the course of their practice. The results when received, if deemed important, will be published in the Transactions. The plan is receiving hearty support.

At the meeting of the Executive Committee in the afternoon the following Associate Members were elected:

John McL. Murphy, Electrical Engineer, Safety Third-Rail Electric Co., 5 Beekman street, Room 223, New York.

F. K. Vreeland, 2nd assis't engineer, Crocker-Wheeler Electric Co., residence, 228 Orange Road, Montclair, N. J.

J. E. Woodbridge, editor Electrical World, 9 Murray street, New York.

The following Associate Members were transferred to membership:

C. H. Wordingham, city electrical engineer, Manchester, England; William Stanley, electrical engineer and inventor, Pittsfield, Mass.

Business News.

NEW INCORPORATIONS.

Council Bluffs, Ia.—The Council Bluffs Gas & Electric Co. has been incorporated, with a capital stock of \$250,000.

Chicago, Ill.—Electric Heat & Power Co. has been incorporated by Chas. B. Coffeen, Alvah S. Hopkins and Howard B. Cook. Capital stock, \$5,000.

Peoria, Ill.—Diamond Meter Co. has been incorporated by E. H. Couch, W. E. Heyle, A. B. Fink and O. A. Scheefer; to manufacture electric meters and other appliances. Capital stock, \$30,000.

Warsaw, Ind.—Warsaw Electric Co. has been incorporated by Noah J. Clodfelter, A. T. Spencer, Charles J. Lohman and J. C. Hamilton. Capital stock, \$30,000.

Chicago, Ill.—Cass & Aaron Co. has been incorporated by Rush Spalsbury, J. Aaron and Philip Cass; to manufacture electrical machinery and supplies. Capital stock, \$10,000.

Montezuma, Ga.—The Montezuma & Oglethorpe Light Company has been incorporated by Jule Felton, V. O. Brown and O. K. Brown; to operate electric and other lighting plant, etc. Capital stock, \$3,000.

Dallas, Tex.—The Sutton-Steele Electrical Manufacturing Co. has been incorporated by Walter L. Steele, Henry M. Sutton and J. L. Sale; to manufacture electric fans, motors and other electrical supplies. Capital stock, \$20,000.

Joplin, Mo.—The Joplin Illuminating Co. has been incorporated with John C. Porter, Harrison J. Drummond, John J. Dunham, Francis Kuhn and Charles Nelson. Capital stock, \$80,000.

Waterbury, Conn.—Waterbury Battery Co. has been incorporated by C. Platt, Charles B. Schaumacht and C. M. Platt. Capital stock, \$10,000.

Ayer, Mass.—Ayer Light and Power Co. has been incorporated with George A. Beatey, president; W. M. Sargent, treasurer. Capital stock, \$50,000.

New York, N. Y.—The Edison Junior Electric Light and Power Co. has been incorporated by Thomas A. Edison, Jr., S. R. Valentine Robinson, H. C. Hepburn, E. A. Drake, C. S. Henry, R. M. Jordan, J. G. Batterson, Jr. and F. J. Stone. Capital stock, \$500,000.

TELEPHONE CALLS.

Carleton, Mich.—The People's Telephone Co., of Wayne and Monroe Counties, held annual meeting recently, and issued a dividend of 10 per cent. to stockholders and elected the following officers: Joseph Waltz, President; F. L. Edward, Secretary; W. S. Morey, Treasurer.

Kenton, Ohio.—Kenton Telephone Co. has been incorporated; to operate a telephone system to Marysville, Bellefontaine, Wapakonita and Lima. Capital stock, \$30,000.

Middleburg, Va.—E. B. Milhollen has closed a contract to construct a telephone line from Middleburg to Plains.

Paducah, Ky.—The city has sold to the highest bidders two telephone franchises. One was bought by the Kentucky Electric Co. for \$100. The American Telephone Co. bought the other. The company operating the present system did not bid.

New York, N. Y.—Fowler Switchboard and Telephone Co. has been incorporated by John T. McRay, Samuel B. Fowler and L. Victor Heckles; to manu-

facture telephone and other electrical fixtures. Capital stock, \$5,000.

New Philadelphia, Ohio—Tuscarawas Home Telephone Co. has been incorporated by James S. Bailey, Jr., Frank W. Bainbridge, John W. Yeagley, O. S. Welty and J. H. Mitchell. Capital stock, \$75,000.

Summerville, Pa.—The Summerville Telephone Co. will extend its line to Big Run and Eleanor.

Dickson, Tenn.—A telephone line will be constructed from Dickson to Charlotte.

Oakland, Cal.—Oakland Messenger, Burglar and Fire Alarm Company has been incorporated by Albert Aucker, Henry H. Beck, Frederick Kahn, Philip Marx, Edward I. Wolf; to build and operate telephone and telegraph lines; conduct a general messenger business, etc. Capital stock, \$20,000.

Lexington, N. C.—The Lexington Telephone Co. has let contract for the extension of its line from Lexington to Salisbury.

Prairie, Ind.—Prairie Telephone Co. has been incorporated with a capital stock of \$10,000.

STREET RAILWAY NEWS.

Detroit, Mich.—The Detroit & Pontiac electric road will be extended to Owosso.

Pittsburg, Pa.—The Braddock Electric Railway Co.; A. L. Sailor and William M. Brown appointed receivers.

Beaumont, Tex.—John C. Ward and others have been granted a fifty-year franchise for an electric railroad.

Fort Smith, Ark.—Fort Smith Traction, Light and Power Co. has been incorporated, with Samuel McLeod President. Capital stock, \$200,000.

Corunna, Mich.—An electric railway will be constructed between Pontiac and Owosso.

Agawam, Mass.—An electric railway will probably be constructed from Agawam to West Springfield.

Dayton, Ohio.—Dayton & Eastern Traction Co. has been incorporated by Henry B. Pruden, George E. Wright, H. O. Cox, Williams A. Mays and W. S. McConnaughey; to operate an interurban electric railway. Capital stock, \$10,000.

Columbus, Ohio.—Dayton & Xenia Traction Co. has been incorporated by J. M. Wilson, O. O. Ozias, F. D. Bitteringer, Isaac G. Kennedy and Philip A. Kemper; to operate an electric railway. Capital stock, \$300,000.

POSSIBLE INSTALLATIONS.

Key West, Fla.—J. L. Watrous has asked for franchise to construct and operate street railway power plant, electric lighting plant, telephone system, etc.

Suffolk, Va.—David Reckard has established works for the manufacture of dynamos and other electrical appliances.

Harpers Ferry, W. Va.—The Harpers Ferry Light & Power Co. has obtained franchise for establishment of an electric lighting plant.

Fredericksburg, Va.—The Mayor may be addressed concerning proposed electric light plant.

Richmond, Va.—The Richmond Paper Manufacturing Co. has contracted for the installation of an electric light plant.

Forsyth, Ga.—W. A. Pye, City Clerk, may give information concerning proposed purchase of electric light plant.

BUSINESS CHANCES.

Ansonia, Conn.—The E. A. Perkins Electrical Co. has increased its capital stock from \$5,000 to \$20,000.

Chicago, Ill.—H. & J. M. Hirsh, electrical manufacturers, gave chattel mortgage for \$500.

Madison, Wis.—The People's Electric Co., electrical supplies, has made an assignment. Liabilities, \$3,500; assets, same.

NEW YORK ITEMS.

MR. C. O. BAKER, JR., of Baker & Co., platinum refiners, Newark and New York, has returned from Europe after an enjoyable trip.

J. R. VANDYCK, manager of the American Impulse Wheel Co., 120 Liberty street, has just returned from an extended business trip. Mr. Vandyck secured a number of large orders while away and appears to be well satisfied with the business outlook.

WILLIAM A. ROSENBAUM, the well-known patent lawyer and expert, Times Building, will deliver a lecture on "The Status of Electrical Invention," before the Electrical Section of the Franklin Institute, of Philadelphia, on November 8.

THE NATIONAL CONDUIT AND CABLE COMPANY, Times Building, has been awarded the contract for the underground construction of the lines of the Third Avenue Railroad Company. The amount of the contract is \$1,500,000.00.

THE MURPHY SWITCHBOARD COMPANY have opened up offices at No. 30 Cortlandt street. The company is under the management of the well-known switchboard manufacturer, Mr. T. J. Murphy, and will find no difficulty in keeping to the front under his able guidance. They manufacture all kinds of switch and panel boards and guarantee to give perfect satisfaction.

MR. GEO. H. BERG, of Geo. H. Berg & Co., 50 Bromfield street, Boston, Mass., general agents for Tirrell Potential Regulator, was in town a short time ago. A representative of The Electrical Age noticed Mr. Berg installing one of the above regulators in the Lords' Court Building, 27 William street. Mr. Berg states that the regulators are giving perfect satisfaction and are meeting with great success among electrical engineers.

The "Review of the River Plate" says: "Buenos Ayres, S. A.—The tricks of the electric light wiremen (as they are pleased to call themselves) in this city are numerous. We have heard of one who did not believe in prepared tape for covering the joints, but made his own by dipping bits of old rag in paraffine. Another excused himself, when it was discovered that half the joints were not soldered, on the plea that he had not had time; but he had found enough time to cover over all the joints with tape, and he waxed wroth when an engineer told him what he thought of him and his work. The excuses made for low insulation are numerous and varied, but no wireman has yet acknowledged that this is due to scamped work. There is such a boom in electric light work now that everybody is going into the business, but many will retire with burnt fingers and dearly bought experience."



WESTON STANDARD

PORTABLE DIRECT READING

VOLTMETERS AND WATTMETERS

For Alternating and Direct Current Circuits.

The only standard portable instrument of the type deserving this name.

Write for Circulars and Price Lists 8 and 9.

WESTON ELECTRICAL INSTRUMENT CO.
114-120 WILLIAM STREET, NEWARK, N. J.

HEADLIGHTS FOR ELECTRIC CARS.

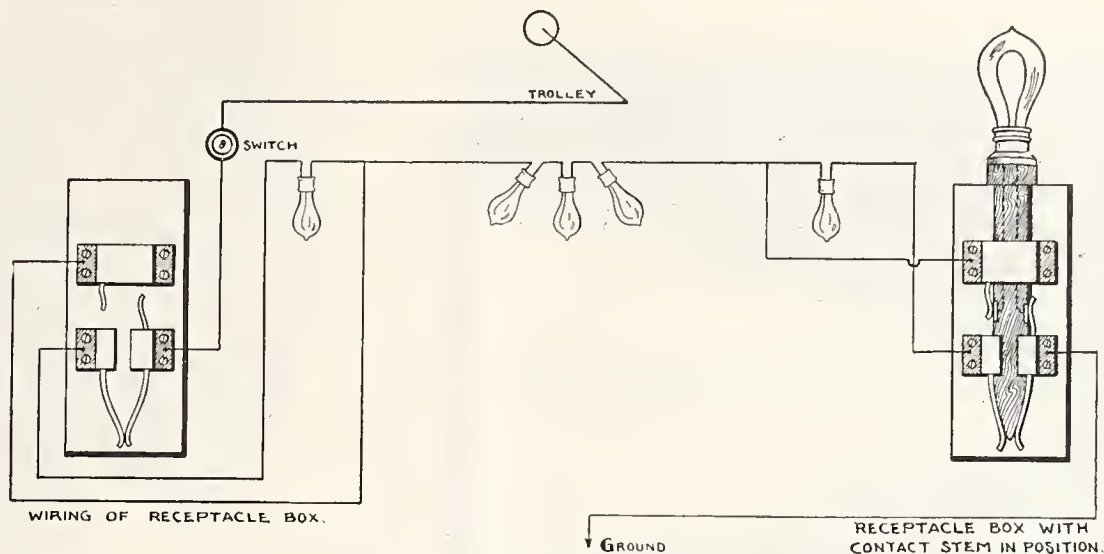


Diagram of Connections for a Five-Light Car.



The above Illustration shows the Motorman ready to make the change from one end of the Car to the other.



The Syracuse Changeable Electric Headlight.

THE SYRACUSE CHANGEABLE ELECTRIC HEADLIGHT.

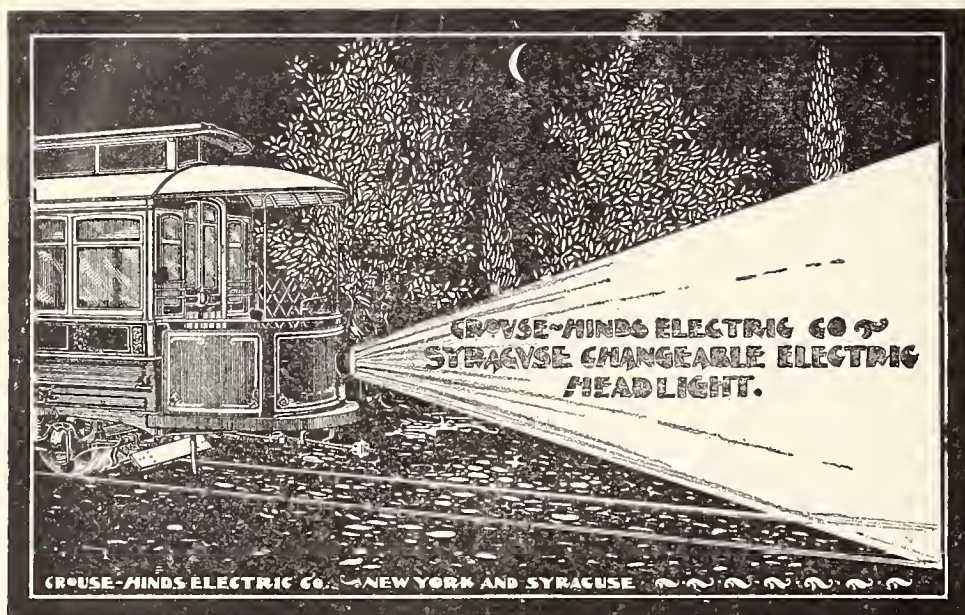
The use of headlights on cars that throw a strong, bright light, and whose attachment to the car is readily performed, has been long felt by street railway corporations. The changeable headlight herein described is constructed with a twelve-in. true parabola reflector of ninety-nine per cent. pure aluminum, highly polished. This reflector, encased in a steel jacket to protect it from injury, throws the light forward without waste or refraction. In front of the parabolic reflector is set a circular glass of double thickness in a solid brass rim, nickel plated. The glass front, twelve inches in diameter, is ably supported by a brass hinge and catch. The steel jacket has attached to it a contact stem made of second-growth hickory waterproofed by boiling in paraffine. At the top of the contact stem a lamp socket is firmly

placed. To the top of the steel jacket a sheet steel handle is attached.

The Crouse-Hinds Electric Co., of Syracuse, N. Y., make two cast iron receptacles, one to be placed on each end of the car. These receptacles are only 10 inches high by 4 inches wide, and are hardly noticeable on the dash of the car, as you may see by referring to the illustration. In the top of these receptacles is a small square hole, just the size of the contact stem on the headlight. A little hinged cover is provided to keep out the water when the lamp is not in position. The contact stem has brass contact plates set in it, with wires running from these plates through the centre of the stem to the lamp socket at the top. Inside the receptacles are brass spring connections. Both receptacles are con-

connected with the light circuit of the car. Push the contact stem into the receptacle at either end of the car, and the brass spring connections in the receptacle both hold the headlight firmly in place and complete the circuit, lighting the lamp in the headlight.

The headlight is automatic in action.

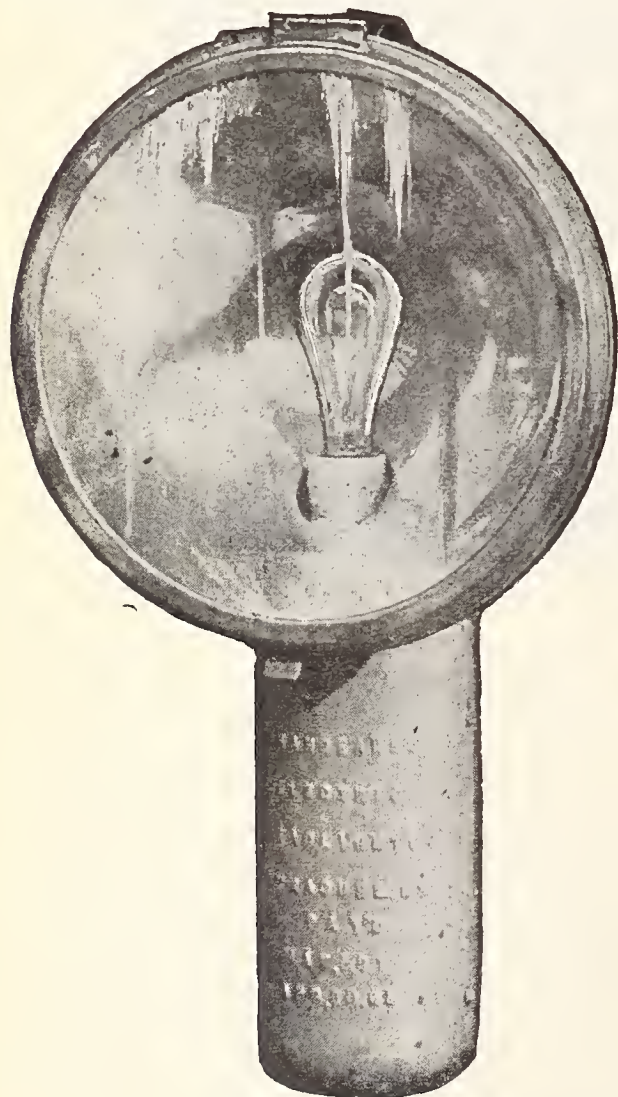


Seowing Reflector when Lighted.

No switch is necessary; simply putting in position lights the lamp.

It can be connected as an additional light, or it can be wired to automatically cut out the corresponding light in the car.

As the headlight projects only seven inches from the dash, it can be left in the receptacle during the day without fear of injury.

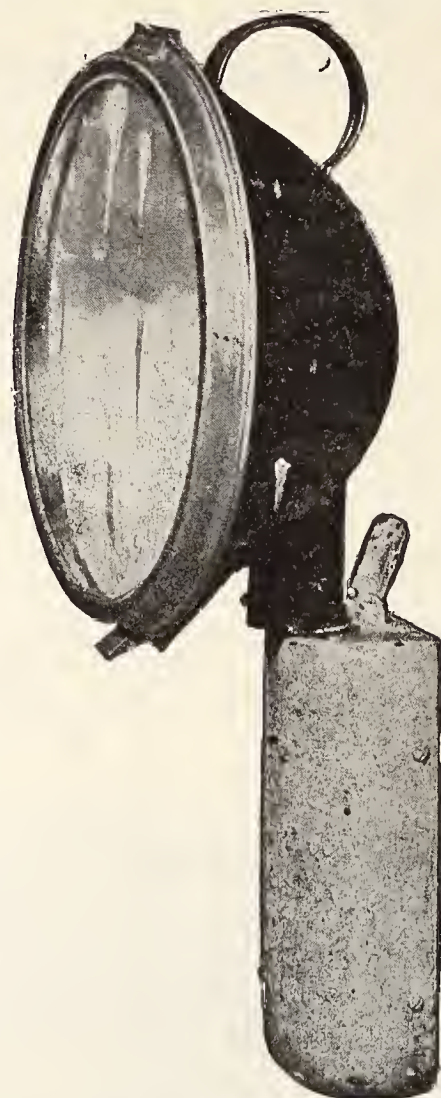


Front View of Reflector.

The receptacle for headlight on dash is light, strong, compact and neat, and never in the way.

The wires from the receptacle are run in a neat gas

pipe with elbow just inside the dash, where they are protected from injury. Wires long enough to reach through



Side View of Reflector.

the gas pipe and platform without joint are furnished with each headlight.

The gas pipe is bolted to the dash at the top and let into the sill at the bottom, making a solid and permanent job.

Lamp socket of any make desired will be furnished with headlight.

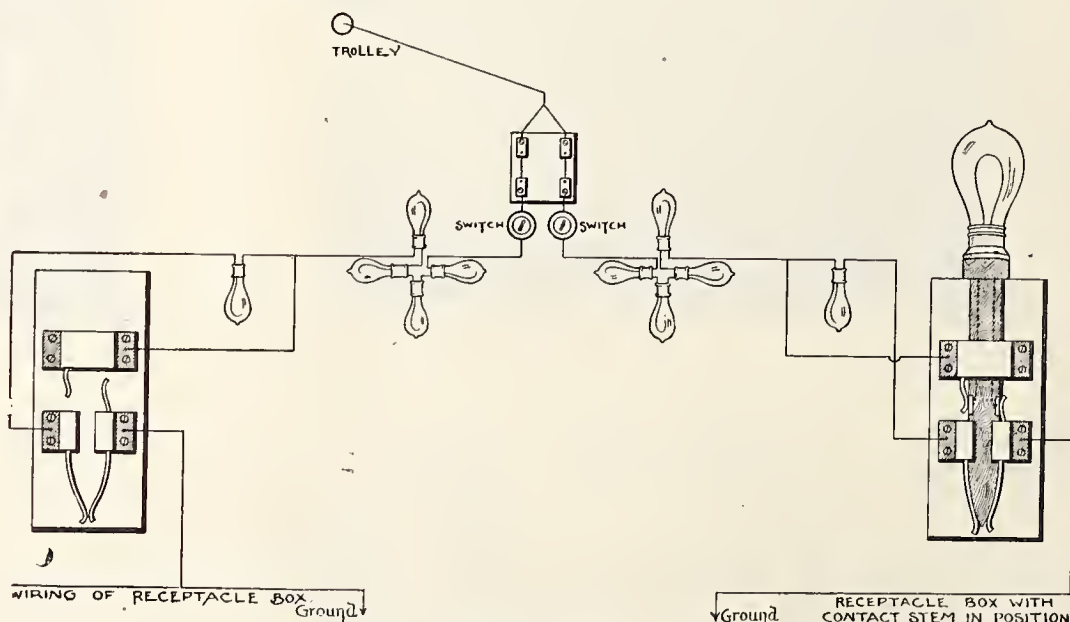


Diagram of Connections for a Ter-Light Car.

They guarantee that you can equip a line with their headlight for less money than with any other headlight that can be purchased. This can be understood when by realizing that only one changeable headlight, instead of two, is necessary for each car, and also take into consideration the fact that a corporation can equip all their cars at the same cost that would be required to equip either open or closed cars alone with any other make of headlight. This can be done by purchasing extra receptacles, which they furnish at a very small cost.

The Crouse-Hinds Co. show that the purchaser cannot afford to use oil headlights for electric cars. The cost of maintaining an oil headlight for an electric car is, at a low estimate, as follows:

Oil, one day.....	\$.02 1/2
Chimneys and wicks one day.....	.00 1/2
Cleaning, filling and care, one day.....	.03

Total, one day..... \$.06
For 365 days..... \$ 21.90

To say nothing of repairs, leaky tanks, bad odor, blowing out in the wind, and reflectors dimmed and ruined by oil.

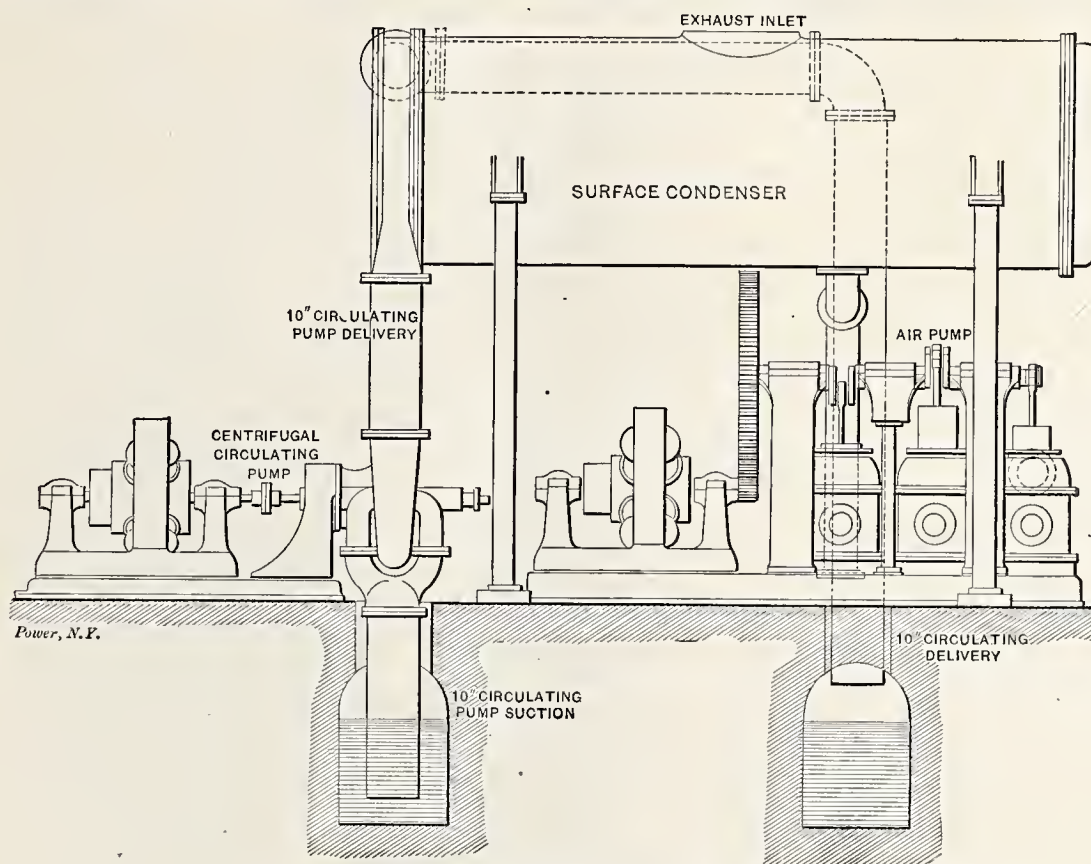
It will be seen from the above that the cost of main-

ELECTRIC LIGHT AND POWER.

THREE THOUSAND HORSE POWER DIRECT-DRIVEN STEAM DYNAMO AT THE STATION OF THE EDISON COMPANY, BROOKLYN, N. Y.

Through the courtesy of "Power."

Our illustration is a view of one of the large direct-driven steam dynamos in the new 66th street station of the Edison Electric Illuminating Company, of Brooklyn, N. Y. The dynamo was described in our issue (Power) of November, 1897; it is a 40-pole, 2,000-kilowatt, 75 revolution, alternating-current machine, with outside stationary



n Air and Circulating Pumps, Edison Station, Brooklyn.

taining an oil lamp for a year is about twice the first cost of electric headlight, which pays for itself the first six months.

The Crouse-Hinds Company have had almost phenomenal success with this headlight, and have been running their factory night and day on them for the past three or four months. They claim to have the best and at the same time the cheapest headlight on the market today, and have made it a policy to send these lamps out on trial free of charge, paying the transportation charges both ways.

They have found in their experience of three years that they do not get more than one lamp in fifty back, and in most every case a sample lamp brings more orders for the goods.

Mr. F. M. Hawkins, Havemeyer Building, 23 Dey street, New York City, is the New York agent for the Crouse-Hinds Electric Company, and carries a large stock of the various styles of the "Syracuse" changeable electric headlight.

Burlington, N. J.—Rivershore Telegraph Co. has been incorporated by Nathan Haines, J. Howard Pugh, George C. Gunn, Mitchell B. Perkins and Henry V. Massey; telegraph and telephone business. Capital stock, \$15,000.

Cleveland, Ohio.—Sands' Electric Co. has been incorporated; to deal in electrical apparatus. Capital stock, \$10,000.

Corsicana, Tex.—The Southwestern Telegraph and Telephone Co. is expending over \$50,000 in the improvement of its plant.

armature and a revolving field. It was furnished by the General Electric Co. The field is mounted upon the shaft of a double horizontal tandem compound side-crank condensing engine, made by McIntosh, Seymour & Co. The engine has two 24-inch high-pressure cylinders and two 48-inch low-pressure cylinders, all of 66-inch stroke. The general arrangement of engine and dynamos is shown by the plan and elevation on page 3.

It will be seen that the dynamo is placed between the two sides of the engine, and that the cranks of the latter are set at 90 degrees. The dynamo is so arranged that the outside armature may be moved along the shaft, allowing access to the field, which is on the engine shaft, and to the armature winding. The engine is rated at 3,108 horse power at 75 revolutions, 1/4 cut-off, 165 pounds' steam pressure and 26 inches of vacuum. Both the dynamo and the engine are built for a considerable overload, the indicated horse power of the latter being 5,000 at a cut-off of 6-10.

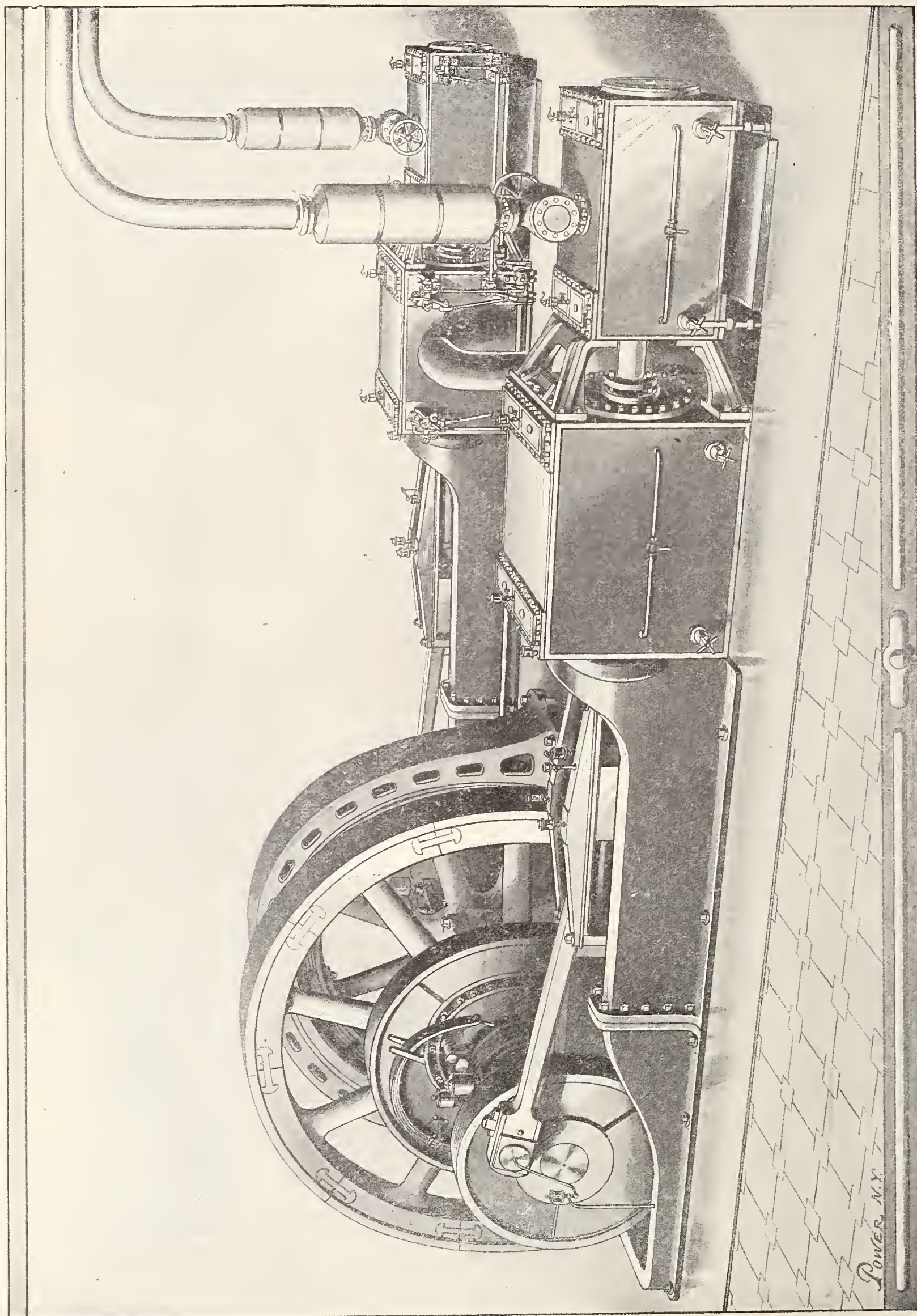
Many of the details of the engine are deserving of special mention; some of them are shown in the outline drawings on page 2.

The shaft is of solid forged steel, 24 inches in diameter in the bearings and 27 inches in the generator fields; it weighs 28 tons. The other portions of the engine are correspondingly large; the main bearings, of which there are two, are each 24 X 42 inches, giving a total bearing surface of 2,016 square inches. The total weight on the two bearings is about 280,000 pounds, giving a pressure of about 140 pounds per square inch of projected diameter. They are provided with removable shells and water jackets. The crank disk is 8 feet 4 inches in diameter,

and the crank pins are 13 inches in diameter and 11 inches long. The cross-head pins are 11½ inches in diameter by 11 inches long, and the bearing surface of the cross

head is 19 × 38 inches.

The fly wheel is large and heavy, being 24 feet in diameter and weighing 82½ tons, or about 53 pounds per



Three Thousand Horse Power Direct Driven Steam Dynamo, at Edison Station, Brooklyn, N. Y.

The Electrical Age.

ESTABLISHED 1883.

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WHAT CONSTITUTES A GOOD STREET RAILWAY SYSTEM.

The choice of electric roads is rather comprehensive on the part of heavy investors. The hour is ripe for a departure bringing with it benefits that appeal to the public as well as the stockholder. From a general standpoint, it cannot be said that a transformation has been effected in the field of street railway work of a character decidedly unique. Were the Brooklyn Heights Railroad Company to remodel their road to such an extent that it would become a huge automatic block system, sectional third-rail system, or any other of that particular nature, this, as an advance, would be decidedly sudden; but, instead, the open conduit has become the system marking the second step forward in the field of street railway work. The grand divisions could be called the trolley, the open-conduit, the automatic-block and the third-rail system. All sorts of combinations have been made, composed of these four elements, but so far the simplest and least scientific has found favor in the eyes of the holder of money bags. It is evident, however, that the second step forward, the building of an open-conduit road, has prepared the way for that system which will inevitably follow, the automatic system.

Thousands of inventors have been laboring at this idea for the last twenty years, and some few have largely succeeded in solving this great problem. Were the conduits of New York to fill frequently with water, the demand for a change would be most emphatic, but their perfect drainage has shown that in this respect the practicability of that system is established. The question is not one relating to the waste of power in the system, but to the first cost of installation to a much greater degree. If an automatic system was less expensive to install and operated with about the same degree of efficiency, in spite of its automaticity it would be well received and adopted in our larger cities.

The unsettled condition of the art in this respect has

led to considerable debate in street railway circles, but the obstinacy that once prevailed therein, opposing innovations of any description, has been swept aside and there is so great a reaction that this fraternity represents one of the most active and progressive in the world. They are quick to take advantage of little inventions, and, as far as greater changes are concerned, would be only too happy to see the installation on all sides of a generally acceptable system, superior to the primitive one now in use.

When this mooted question has been definitely settled, tremendous interests affecting our great trunk lines will become involved, and the new generation will be whirled from the Atlantic to the Pacific by a course whose advent has already wrought marvelous changes in the economy and relation of civilized powers.

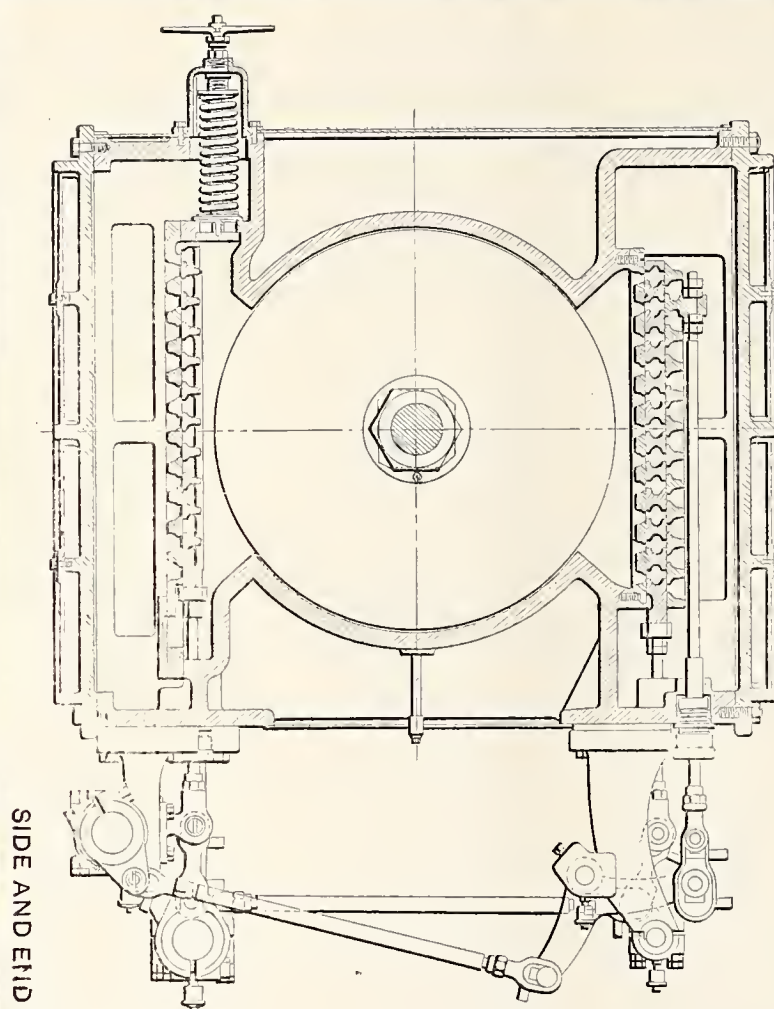
THE USE OF ELECTRICITY IN THEATRES.

With the prospect of a busy season in theatrical circles and the immediate possibility of grand opera becoming a popular topic, the stage manager, or, rather, the business manager, of our most prominent theatres turns his attention to the heating, lighting and ventilating of the institution in his care. From a hygienic standpoint, electricity in the theatre is a permanent factor, by the utilization of which pure air, clear light and a grateful warmth is diffused. It seems that our English friends at the Savoy Theatre, London, first undertook to light this establishment by electricity. Mr. D'Oyley Carte, aided by the efforts of Messrs. Siemens Brothers, the distinguished electrical engineers, succeeded in demonstrating in a most practical manner that electric lighting in theatres was an accomplished fact.

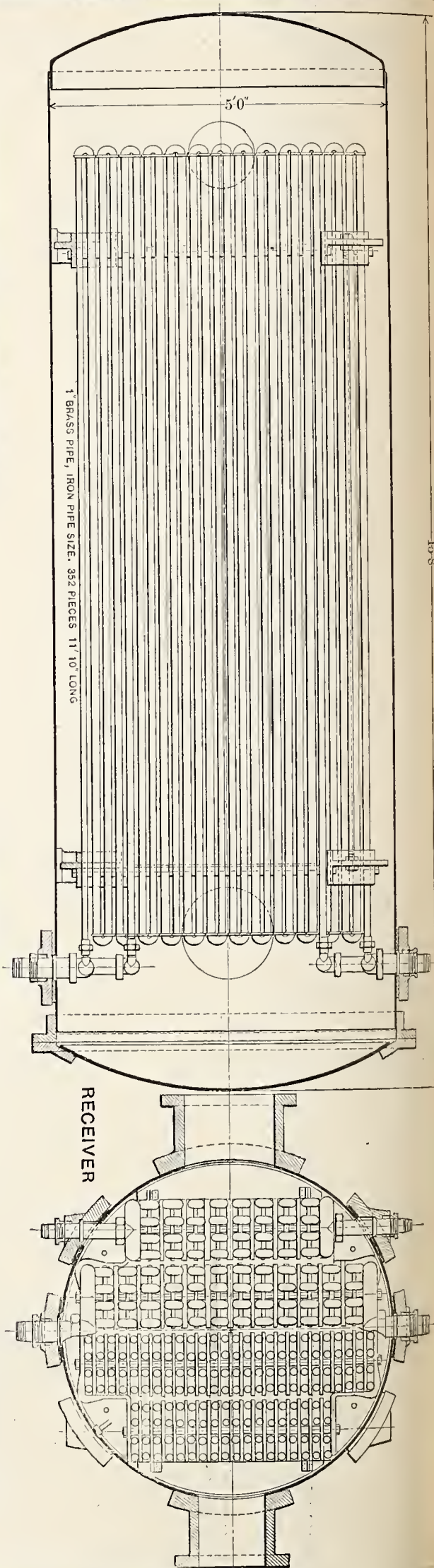
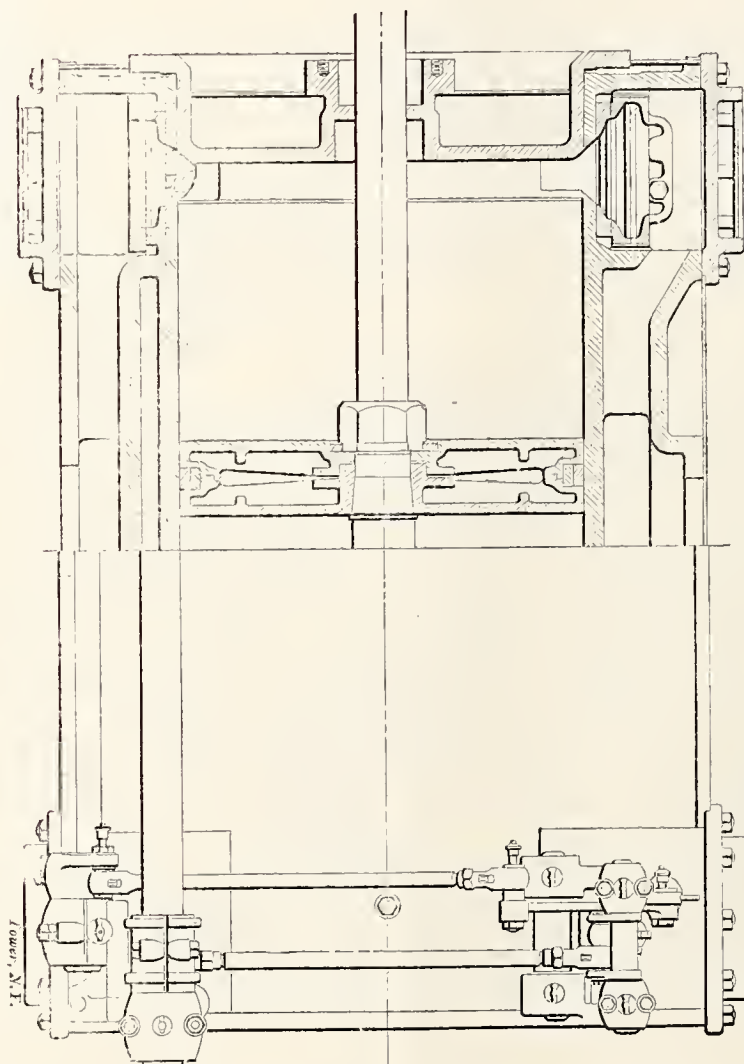
Today the theatres of Greater New York make use of the electric current as an indispensable adjunct of their work. The entrance of the kinetoscope, cinematograph and other varieties of the same instrument have made the hand and automatic-feed focussing lamp a welcome addition to theatrical purposes. In fact, the name of the stage electrician is regularly inscribed on the programme, as much of the success and smoothness with which a play runs on depends upon the efficiency and ready ability of the stage electrician. The interest pertaining to his occupation grows when his aid is required in creating the magic effects viewed by an entranced audience at the grand opera. To us to whom the illusion is complete the details connected with success are comparatively unknown. The stage electrician, as it were, carries them up his sleeve, but with the appearance of a great Wagnerian exponent or a disciple famous in the field of drama, magnificent illusions are produced which aid wonderfully the art of the singer or actor. Perfection in this respect may be so reached that it becomes an art that hides the art.

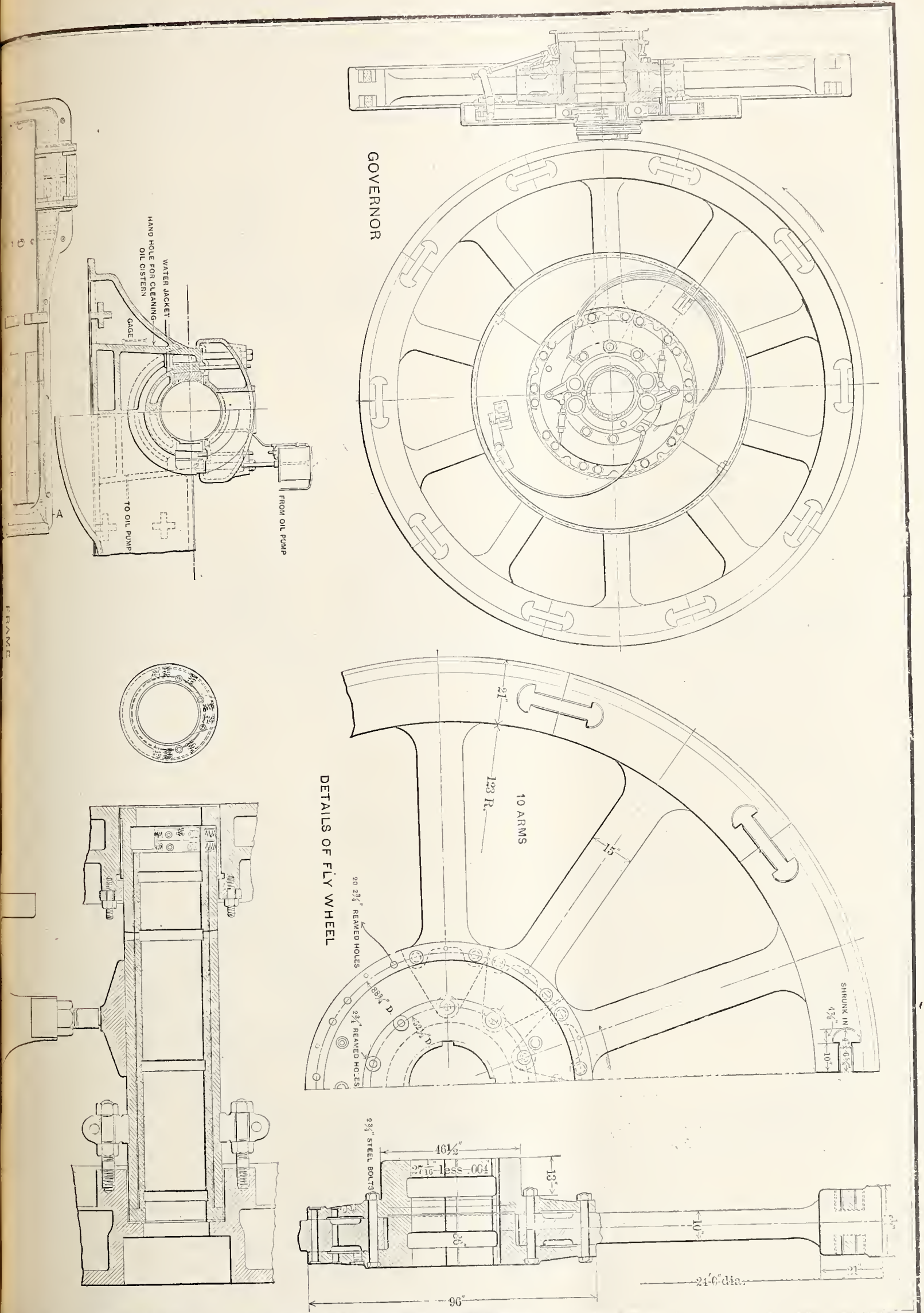
The "Tempest" of Shakespeare and the great scenes produced in the operas of Wagner, Franchetti and Verdi require the closest study and attention on the part of the stage electrician. The throwing and blending of light at the proper moment, the gradations required for the successful imitation of sunrise and sunset, and various other adaptations to Nature certainly call for more intelligence than that required for the mere manipulation of switches. The duties of the stage electrician are frequently composed of others relating to the ventilation, heating and lighting of the theatre.

The enclosed arc lamp has found a foothold in its most modern form, electric radiators controlled to give any degree of heat are in vogue, and small electric fans or possibly great exhausts supply sufficient comfort and convenience to the theatre-goer to make his three-hour visit a matter of complete enjoyment. If modern science supplies fresh air, warmth, good light and part of the stage effects, the responsibility is thereby greatly lessened of making a play successful which rests entirely with those occupying the stage itself.



SIDE AND END ELEVATIONS OF CYLINDER



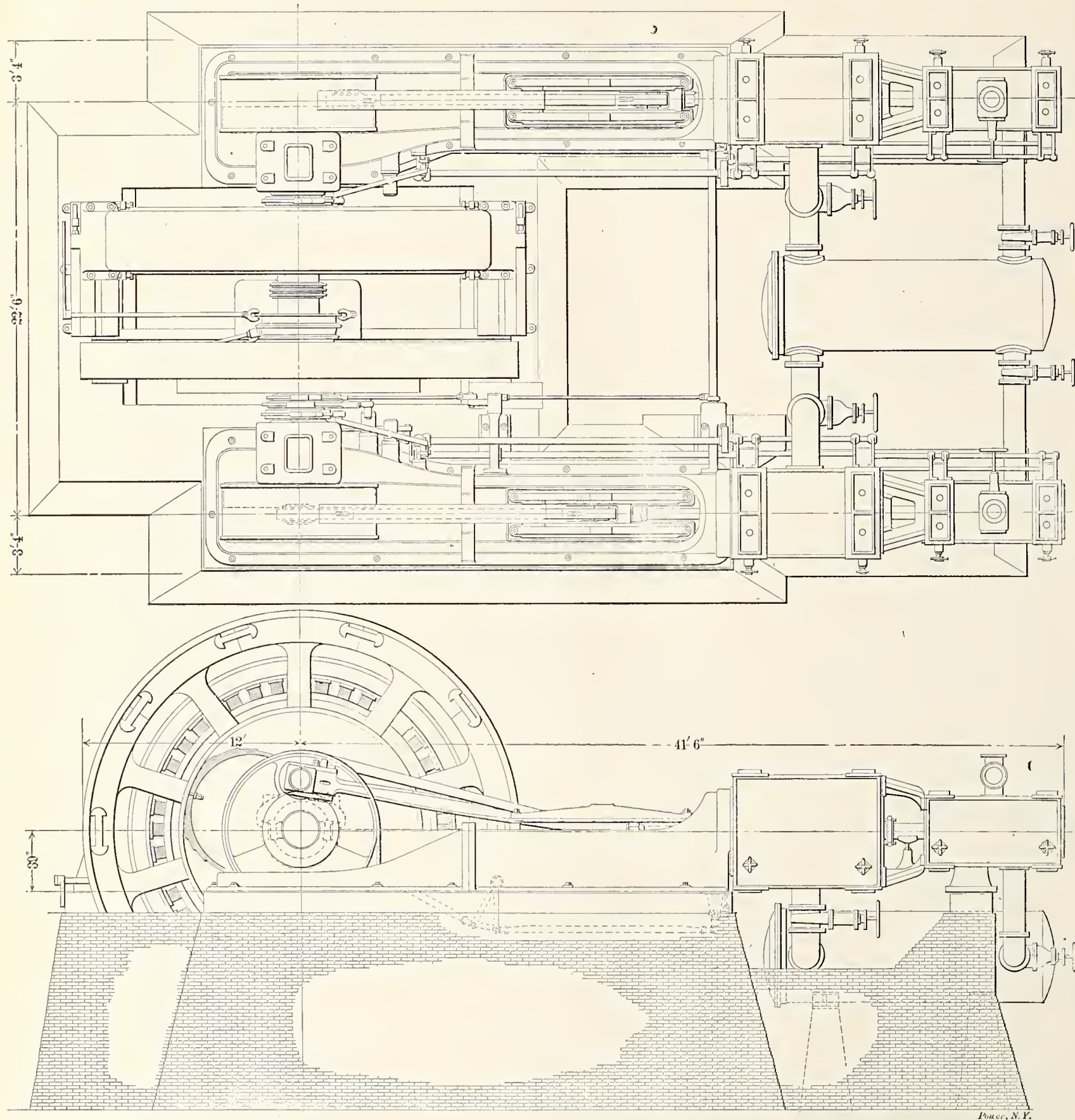


rated horse power. The rim is 24 inches face and 22 inches deep, and weighs about 58 tons, or 37 pounds per rated horse power. It has 10 oval spokes, each cast solid with a section of the rim. The rim sections are fastened together by steel arrow-points, weighing about 300 pounds each, shrunk in. The hub is a casting forced on the shaft by hydraulic pressure, and the spokes are joined to it by 3 $\frac{23}{4}$ -inch turned bolts each.

The valves are of the gridiron type, at four points of each cylinder; the upper valves being for steam and the

eccentrics. There are two of these governor eccentrics, one for each of the twin engines.

The fly wheel, governor wheel and eccentrics being nearer the left-hand engine, a cross-over shaft under the floor is used to communicate the motion to the cut-off gear on the right-hand side of the engine. The governor eccentrics are revolved upon the main shaft by the action of the governor and their angular advance is dependent upon the load and the corresponding position of the governor. The movement of the valves is across the cylin-



Plan and Elevation 3,000 Horse Power Direct Driven Steam Dynamo Edison Station, Brooklyn.

lower for exhaust. The main valves control the admission of the steam and the opening and closing of the exhaust; they are positively driven, being operated by links from a rock-shaft driven by a bell-crank, which is actuated by links from fixed eccentrics on the main shaft just inside the main bearings. The cut-off valves are also of the gridiron type, and ride on top of the main valves; their movement is imparted by a second rock-shaft on each engine. These auxiliary or cut-off rock-shafts derive their motion from bell-cranks driven by links from the governor

der or at right angles to the piston movement. By disconnecting the connecting rod and one link of the cut-off gear, either side of the engine may be run as an ordinary tandem compound engine of 1,500 horse power; valves being placed in the receiver pipes for this purpose.

The links of the valve-gear are all provided with adjustable brass boxes, and the valve-stems are also adjustable. The clearance required by this type of valve is very small, being but 1 7-10 per cent. in the high-pressure cylinder and 2 2-10 per cent. in the low-pressure cylinder.

The connecting rods are $7\frac{1}{2} \times 9\frac{1}{2}$ inches in section at the centre, and are provided with gib and key adjustment at the ends; pinching-bolts are used to prevent the spreading of the strap. The boxes at both ends are lined with Babbitt metal, hammered in and bored. The piston rods are $7\frac{1}{2}$ inches in diameter, made tapering in the pistons. The pistons bear against shoulders on the rods and are secured by a nut and locking device shown in the outline drawing.

The rod runs in a babbitted sleeve between the cylinders, and an adjustable jack, resting on the split connecting head between the cylinders, supports the weight and provides means for keeping the pistons central in the cylinders. The sleeve is made to be turned 120 degrees at a time, giving three wearing surfaces.

The governor is placed in a flanged disk bolted to the fly wheel; it is clearly shown in the engraving.

At the time this engine was purchased it was considered necessary to provide some means of bringing the several alternators to synchronism before they could be satisfactorily operated in parallel. To this end the builders of the engine devised the governor attachment shown in the outline drawing. The 3-flanged friction pulley shown in the cross-sectional view is loose on the shaft and may be shifted laterally by an ordinary clutch-operator or shifter. This lateral movement brings one or the other of its two right-hand flanges into contact with the small leather-faced disk on the upper end of the diagonal rod. The rotary movement thus imparted to the rod screws it in or out of the nut at the bottom; this in turn varies the tension on the single-leaf auxiliary spring in the governor by means of the connecting levers.

This auxiliary spring acts in conjunction with the main governor spring, and any change in its tension affects the action of the governor, so that the engine speed may be varied while running to suit the requirements of the other machines. The governor and valve gear allow a range of cut-off from 0 to 8-10 of the stroke. The exhaust steam from the high pressure cylinders enters a common reheating receiver, shown on page 2.

This receiver has a brass reheating coil containing steam at boiler pressure. The high-pressure cylinders have steam jackets on both barrel and heads, and these jackets and the receiver are piped in series, so that a constant circulation is ensured by the partial condensation of the steam in the receiver coils. The low-pressure cylinders are provided with warming pipes, and both cylinders have water-relief valves at each end. The steam pipes are each 9 inches and the exhaust pipes 20 inches in diameter.

The lubricating system is of considerable interest. On a shelf between the high and low-pressure cylinders are three automatic force-feed lubricators of the ratchet and pawl type, driven by links from the valve rock-shaft. The first of these lubricates the high-pressure cylinder, the second lubricates the low-pressure cylinder, and the third forces oil into the sleeve between the cylinders. The usual hand pumps are also provided. The crank pin is oiled by the usual centrifugal oiler, and the wrist pin has an oiler of the boat type.

The main bearings are automatically lubricated from tanks on the pillow blocks. Oil reservoirs are provided in the pedestal, and small plunger pumps operated by the valve gear return the oil to the tanks.

The engines are equipped with Cochrane combined steam separators and receivers, built by the Harrison Safety Boiler Works, and are placed directly on the throttle valves. The two condensers are of the surface type made by Henry R. Worthington.

A peculiar feature of this installation is the fact that no steam-driven auxiliaries are used, and the arrangement of the air and circulating pumps is as shown in the engraving on this page. The condensers are placed directly below the engine receiver and are supported by standards from cast-iron base plates, on which the air

and circulating pumps are mounted. The air pumps are of the triplex steeple type, connected by means of gears to multipolar slow-speed motors of General Electric make. These pumps have each 6-inch suction and 6-inch discharge. The circulating pump is of the centrifugal type, and is direct-coupled to a multipolar motor running at about 600 revolutions per minute.

The entire arrangement of condensers and pumps is very neat and compact and should be economical in operation. Directly in the rear of the main engine are two 6-pole, 50-kilowatt, 400-revolution, direct-current exciters, each direct-coupled to a 9 and 15×16 -inch vertical marine type engine of General Electric make.

The makers of the engine make the following guarantees in addition to the usual ones concerning material, workmanship and smooth running:

(1) That the engine will regulate from no load to one and one-quarter the rated load within $1\frac{1}{2}$ per cent. variation of speed.

(2) That the fluctuations in speed under sudden changes in load, amounting to not more than one-half the rated load (the total load not exceeding one and one-quarter the rated load) will not exceed $\frac{3}{4}$ of one per cent.

(3) That the steam consumption under the most economical conditions will not exceed $13\frac{1}{2}$ pounds of dry steam per indicated horse power per hour.

STRAY CURRENTS.

TELEPHONES IN GERMANY.

The most recent telephone statistics for the German Empire bring the numbers up, for Prussia to October, 1897; for Württemberg to April, 1897; for Bavaria only to January, 1897. The general aspect is certainly satisfactory, as a few numbers referring to 1897 and 1894 (in parentheses) will sufficiently indicate. There were 632 (461) towns or places, with 164,681 (110,894) telephone stations and 240,127 (154,435) kilometres of lines, on which 1,440,657 (1,078,865) conversations took place daily. The long distance lines had a length of 90,512 (48,627) kilometres, and 191,884.—Ex.

AN ELECTRIC TRAMWAY IN ITALY.

It is proposed to build an electric tramway between Rome and Genzano, with a branch in the direction of Bocca di Papa. The line will be of normal gauge, and the rails will be laid on oak sleepers placed at distances of about 3 ft. apart. The steepest gradient will not exceed 9 per cent., and the sharpest curve 92 ft. radius. The length of the line will be about 26 miles, divided into three nearly equal sections forming a Y. According to "L'Industrie Electrique," the generating station is to be at Capanne de Marino (at the centre of the Y), and will comprise five Dowson gas engines, each of 120 horse power, driving continuous-current dynamos. One of these three sets constitutes a reserve. The station will also supply light to the streets and villas of Castelli Romani. The adoption of gas engines is primarily due to the lack of water. Overhead distribution at 1,200 volts is used, with the rails as return. Motor cars are to be used, with one or two trailers as required. The speed will vary from $9\frac{1}{2}$ to $18\frac{1}{2}$ miles an hour, and each motor will carry two 35-horse power motors.—Ex.

SELF-HARDENING

STEEL MAGNETS.

In a recent issue of the American Journal of Science are given the results of tests of a large number of magnets made of self-hardening steel, now in common use for lathe tools. The object of these tests was to search for a material for standard measuring magnets which would be as permanent as possible, and have a small temperature and induction coefficient. The experiments show that comparatively short

seasoned magnets made of this steel have decidedly smaller induction coefficients than magnets of the same dimensions made of tool steel; the difference in the temperature coefficient is much less, but the advantage is still on the side of those made of self-hardening steel; the temperature and induction coefficients of long magnets of the two kinds of steel do not seem to be very different.—Ex.

AMERICAN

MACHINERY IN

THE FAR EAST.

The Westinghouse Electric & Manufacturing Company has taken a contract for machinery to go to China. Consul Ragsdale of Tientsin, under date of July 9, 1898, speaking of the arrival of the new United States Minister, Mr. Conger, mentions the general popularity of Americans in China. Expressions of friendship for our people, he says, are heard in official and business circles. He notes a contract just made by a representative of the Government with Mr. Difenderfer of Philadelphia, for the purchase of all machinery necessary to establish an up-to-date woolen mill at Tientsin. The electrical machinery will come from the Westinghouse Electric Company of Pittsburgh, the boilers and engines from the Harrisburg Foundry & Machine Company, and the remaining machinery from the James Smith Woolen Machine Company of Philadelphia.—Ex.

RAILWAY

TELEPHONES.

A telephone experiment is to be tried upon the Baltimore & Ohio that will involve using the telephone for long-distance communication. Work will begin in a few days on the construction of the new copper telegraph lines between Baltimore and Pittsburg, 340 miles, and they will be so arranged that when the necessity arises they will be available for telephonic communication. One of the wires will be extended as far as Newark for telegraphic use. A new line has also been constructed between Columbus and Cincinnati. It will take 800 miles of copper wire, weighing 166 lbs. to the mile, to complete the work.—Ex.

THE BOSTON SUBWAY.

Boston's subway, which was built for a little less than its estimated cost of \$5,000,000, has been finished and thrown open to the use of the public. The work was begun a little less than 3½ years ago, and in its completed state comprises 12.3 miles of tunnel, with 5 miles of railroad track, and in furnishing the means for underground electric transit relieves a congestion in street traffic that was a great nuisance. The subway is the first underground electric road in this country, and its operation will be watched with keen interest. The commission that had charge of the improvement has made plans for a tunnel to East Boston, and has plans for several routes from which a selection is to be made.—Ex.

TELEGRAPHING WITHOUT WIRES

THE DEVELOPMENT OF WIRELESS TELEGRAPHY.

By Sir William Crookes.

The fundamental discovery by Hertz of the electromagnetic waves predicted more than thirty years ago by Clerk Maxwell, says the "Electrical World," seems likely to develop in the direction of a practical application which excites keen interest—I mean the application to electric signaling across moderate distances without connecting wires. The feasibility of this method of signaling has been demonstrated by several experimenters at more than one meeting of the British Association, though most elaborately and with many optical refinements by Oliver Lodge, at the Oxford meeting in 1894. But not until Signor Marconi induced the British post-office and

foreign governments to try large-scale experiments did wireless signaling become generally and popularly known or practically developed as a special kind of telegraphy.

Its feasibility depends on the discovery of a singularly sensitive detector for Hertz waves—a detector whose sensitiveness in some cases seems almost to compare with that of the eye itself. The fact noticed by Oliver Lodge in 1889, that an infinitesimal metallic gap subjected to an electric jerk became conducting, so as to complete an electric circuit, was rediscovered soon afterward in a more definite and tangible form and applied to the detection of Hertz waves by M. E. Branly. Oliver Lodge then continued the work, and produced the vacuum filing-tube coherers with automatic tapper-back, which are of acknowledged practical service.

It is this varying continuity of contact under the influence of extremely feeble electric stimulus alternating with mechanical tremor, which, in combination with the mode of producing the waves revealed by Hertz, constitutes the essential and fundamental feature of "wireless telegraphy."

There is a curious and widely spread misapprehension about coherers, to the effect that to make a coherer work the wave must fall upon it. Oliver Lodge has disproved this fallacy. Let the wave fall on a suitable receiver, such as a metallic wire, or, better still, on an arrangement of metal wings resembling a Hertz sender, and the waves set up oscillating currents which may be led by wires (enclosed in metal pipes) to the coherer. The coherer acts apparently by a species of end-impact of the oscillatory current and does not need to be attacked in the flank by the waves themselves.

This interesting method of signaling—already developing in Marconi's hands into a successful practical system, which inevitably will be largely used in lighthouse and marine work—presents more analogy to optical signals by flash-light than to what is usually understood as electric telegraphy; notwithstanding the fact that an ordinary Morse instrument at one end responds to the movements of a key at the other, or, as arranged by Alexander Muirhead, a siphon recorder responds to an automatic transmitter at about the rate of slow cable telegraphy. But, although no apparent optical apparatus is employed, it remains true that the impulse travels from sender to receiver by essentially the same process as that which enables a flash of magnesium powder to excite a distant eye.

TRANSMISSION OF POWER.

THE APPLICATION OF ELECTRICAL MOTORS TO MACHINE TOOLS.

Since 1892 the Mulhausen-Grafenstaden-Belfort Engineering Company has given special attention to the problem of using electric motors for the driving of machine tools, and a series of tests was made to find the best arrangement for varying the speed while obtaining the maximum possible efficiency. After general remarks concerning the various speeds and gears required for different types of machine tools, the author proceeds to describe actual tests of three methods of transmission: (1) Disk and plate; (2) Sellers friction; (3) belt of trapezoidal section. In the first section the following were tested: (a) Sole leather on cast iron; (b) compressed paper on cast iron; lignum vitæ on cast iron; hardened steel on cast iron, and the Sellers disk with cast iron on gun metal.

The electric apparatus consisted of a shunt-wound motor for 110 volts and 3 horse power at 1,200 revolutions per minute, a voltmeter for 120 volts, an ammeter to read up to 7 amperes, and one to read up to 25 amperes, with switches and adjustable resistance. The mechanical apparatus consisted of a bedplate carrying two Sellers bearings carrying a shaft, upon which was fixed a pulley with a Prony brake, a speed counter-pulley

and a lever arrangement to measure the end pressure exerted upon the driving gear. The pulley of the Prony brake ran in a bath of soap and water. The whole apparatus was designed to enable the coefficients of friction of the various transmission mechanisms to be readily obtained. The whole of the calculations are given at great length, and finally the results are collected in tabular form, and the values are given for horse powers varying from 0.5 to 25. From these the following results for 2 horse power may be selected as fairly typical:

Coefficient of Friction.				Efficiency.	
E. H. P.	S. H. P.				
2.861	2.130	0.339	0.7193	{	Disk and roller, leather on cast iron.
2.764	2.113	0.420	0.7644		Disk and roller, compressed paper on cast iron.
2.764	2.115	0.352	0.7688		Disk and roller, lignum vitæ on cast iron.

From the series of results given in the original the author concluded that the disk and roller are suitable, under certain conditions, for altering speeds for motors up to 2 horse power.

With respect to Sellers disks, the author concludes that the efficiency is lower than that of the disk and roller, but that the apparatus may be used for small powers at speeds not exceeding 1,000 revolutions per minute. The experiments on the transmitting powers of leather belts of a trapezoidal or wedge section are compared with similar results obtained for ordinary flat leather belts. The belt groove has sides inclined to one another at 40 deg. The belt speeds were 1,236, 2,472 and 4,944 feet per minute. With the apparatus in question, it was not possible to obtain the coefficient of friction for the belts, but it was clearly proven that their efficiency was far greater than those of the other methods already described. The author describes various forms of machine tools, and points out how much less room speed cones for wedge-shaped belts take up than cones for ordinary belts.—British Inst. C. E.: Foreign Abstracts.

THE ELECTRIC FURNACE.

THE ELECTRICAL FURNACE AS USED BY MOISSAN.

In a foreign technical journal, Mr. Rudolf Mewes gives an account of the employment of the electric furnace and of the efforts made, before its introduction, to attain very high temperatures. It is pointed out that Moissan claimed for his furnace that it was an appliance strictly for scientific research and not for technical uses. According to the nature of the work to be undertaken, there were five varieties of furnaces, and the strength of the currents employed varied between somewhat wide limits. Diagrams are given of the furnace, and an outline follows of the various researches undertaken by Moissan on the volatilization of certain refractory substances. These served as the basis of experiments upon the crystallization of the oxides of calcium, strontium, barium, magnesium and aluminum, and the oxides of the iron series. Subsequently he investigated the reactions in the electric arc of the metalloids—silicium, boron and carbon, and the distillation of silicic acid.

His later experiments upon the production of carbides and double carbides have led to discoveries which, in the case of calcium carbide, are capable of practical industrial application. He has recently succeeded in producing artificial diamonds by causing molten iron to take up large quantities of carbon; the crucible containing the glowing mass is then rapidly withdrawn from the furnace and plunged into cold water. The result of this is that an outer solid coating is formed which occupies a less volume

than the heated mass within, and exerts great pressure on the interior during the cooling process, in the course of which the diamonds crystallize out.

AMONG THE SOCIETIES.

The Engineers' Club of Philadelphia held a meeting Saturday, November 5, at eight P. M., at its house, No. 1122 Girard street. Two papers were read: "Notes on Recent Progress in Electrical Engineering," by Carl Herring, and "Coal Handling Machinery," by Charles Piez. Secretary, L. F. Rondinella.

The Faraday Scientific Society opened its first lecture course, Saturday evening, October 29. The following lectures have been given: "Electro-dynamics," by Maxwell J. Adler, "The Gyroscope," by Otto Greenberg; Maxwell's "Action at a Distance," by Harris Goldstein.

The following lectures are to be given:

- Nov. 19—"Photography," by Henry I. Lurye.
- Nov. 26—"Steam," by Joseph Miller.
- Dec. 3—"Liquefaction of Gases," by David Landau.
- Dec. 10—"Psychology," by Abraham Levy."
- Dec. 17—"Physical Science in Warfare," by Maxwell J. Adler.
- Dec. 24—"On the Fundamental Concepts of Electro-Magnetics," by Harris Goldstein.
- Dec. 31—"Volcanoes and Geysers," by Joseph Miller.
- Jan. 7—"Electrical Resonance," by Otto Greenberg.
- Jan. 14—"Acetylene Gas," by David Landau.

The lectures are given at the Educational Alliance Building, East Broadway and Jefferson street, New York City, every Saturday evening, at eight P. M.

NEW YORK ELECTRICAL SOCIETY.

Mr. E. H. Johnson, president of the Sprague Electric Company, will lecture before the New York Electrical Society on Thursday evening, November 17, at eight P. M., on "Surface Contact Railways, with special reference to the Johnson-Lundell System."

Business News.

SPECIAL EXPORT COLUMN.

TOTAL ELECTRICAL EXPORTS, WEEK ENDING NOV. 7, 1898, \$53,044.00.

New York, N. Y. Nov. 7, 1898. The following exports of electrical material are from the port of New York for the week ending this date:

- Antwerp—4 cases electrical material, \$2,821; 10 packages electrical machinery, \$600.
- Africa—3 cases electrical material, \$457.
- Argentine Republic—114 cases electrical material, \$5,597; 30 cases electrical machinery, \$2,781; 1 case electros, \$2.
- Brazil—2 cases electrical material, \$110.
- British Possessions in Africa—4 cases electrical material, \$146.
- Bremen—6 cases electrical material, \$500.
- British Guiana—8 packages electrical material, \$359.
- British West Indies—186 electrical material, \$16,867.
- Cork—4 cases electrical machinery, \$166.
- Cuba—44 cases electrical material, \$1,159.
- Central America—16 cases electrical material, \$285.
- Chili—15 cases electrical material, \$189.
- Dutch West Indies—3 cases electrical material, \$37.
- Dresden—2 packages electrical material, \$27.
- Ecuador—6 cases electrical material, \$125.
- Glasgow—8 packages electrical material, \$856; 4 cases electrical machinery, \$123.

Hong Kong—11 cases electrical material, \$714.

Japan—2 electric motors, \$790.

London—184 cases electrical material, \$7,200; 21 cases electrical machinery, \$1,560; 1 case electros, \$117.

Liverpool—12 packages electrical machinery, \$220; 12 cases electrical material, \$291.

Mexico—17 cases electrical material, \$792; 5 cases electrical material, \$50.

Newfoundland—6 packages electrical material, \$58.

Nova Scotia—1 package electrical material, \$24.

Newcastle—16 packages electrical material, \$25.

Odessa—29 cases electrical material, \$916.

Peru—21 cases electrical material, \$387; 3 cases electrical machinery, \$490.

Porto Rico—60 packages electrical material, \$1,304.

Rotterdam—1 case electrical machinery, \$300.

Siam—27 packages electrical material, \$700.

Santo Domingo—8 cases electrical material, \$75.

Southampton—8 cases electrical material, \$628.

Uruguay—1 case electrical machinery, \$739; 8 cases electrical material, \$203.

U. S. Colombia—44 packages electrical material, \$1,154; 3 cases electrical machinery, \$704.

Venezuela—2 packages electrical material, \$27; 7 cases electrical material, \$80.

POSSIBLE INSTALLATIONS.

Hagerstown, Md.—The Mayor may be addressed concerning establishment of electric light plant.

Spartansburg, S. C.—The Aetna Light & Power Co. will have plans and specifications prepared for a new gas and electric light plant.

Franklin, Tenn.—D. F. Gardner is reported to be interested in the establishment of an electric light plant.

Woodsfield, W. Va.—The Town Clerk may be addressed concerning electric light plant, for which bonds will be issued.

Yazoo City, Miss.—L. G. Montgomery is reported to be interested in the establishment of an electric light plant.

Charlevoix, Mich.—City Clerk may be addressed concerning proposed establishment of electric lighting plant.

Henderson, Tenn.—City Clerk may be addressed concerning proposed electric light and street railway service.

STREET RAILWAY NEWS.

Fort Smith, Ark.—The Fort Smith Traction, Light & Power Co. has been incorporated by Alfred N. Sicard, Ella E. Sicard, Richard C. Kern, Charles H. Smith and others. Capital stock, \$200,000, of which \$100,000 has been subscribed and paid up.

Newport News, Va.—The Newport News & Old Point Railway & Electric Co. will expend about \$200,000 in improving the railway, light and power plants which it has purchased, and in erecting a new electric-power plant.

Middletown, N. Y.—The Middletown Traction Co.; receiver has been appointed.

TELEPHONE CALLS.

Germantown, Ky.—The Germantown, Minerva & Maysville Telephone Co. has been incorporated by J. F. Walton, S. D. Rigdon, T. M. Dora, Evan Lloyd and others.

Greensburg, Ky.—Green County Telephone Co. has been incorporated with a capital stock of \$3,500.

NEW INCORPORATIONS.

Portland, Me.—Mitchell-Parson Electric Co. has been incorporated by Geo. A. Copeland and Wm. E. Parson; to manufacture electric car appliances. Capital stock, \$150,000.

Camden, N. J.—Citizens' Light, Heat & Power Co. has been incorporated by Andrew S. Scull, Joaphim R. Moon and Wesley Bartine; to manufacture electricity for light, heat and power. Capital stock, \$100,000.

NEW YORK ITEMS.

H. STILLSON HART has opened up offices in the White Building, 95-97 Liberty street, for the Fostoria Incandescent Lamp Co. This will also be the eastern office of the Crouse-Tremaine Carbon Co.

THE MONTAUK MULTIPHASE CABLE COMPANY are making an exhibit of their interior thermostatic fire cables at the twentieth Triennial Exhibition of the Massachusetts Charitable Mechanics' Association at Boston. The exhibit is in charge of Mr. Lucian W. Jenney, who also had charge of their exhibit at the Electrical Show in this city last May.

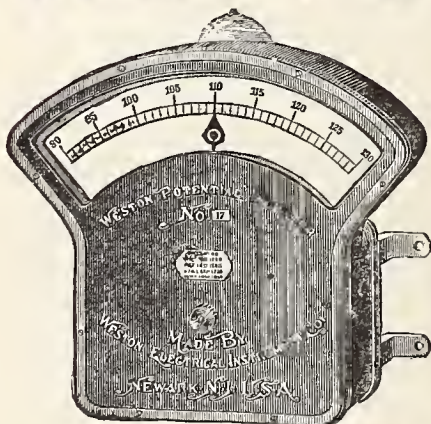
THE AMERICAN ENCLOSED ARC LAMP, manufactured by C. J. Bogue, 215 Centre street, has made a great hit, and orders for the lamp are literally pouring in thick and fast.

MR. ELMER P. MORRIS, the well known electrical supply agent, of 15 Cortlandt street, is well satisfied with present business conditions, the many fine orders which he is receiving contributing largely to his satisfaction.

THE INDIA RUBBER & GUTTA PERCHA INSULATING COMPANY are about completing a \$250,000 contract for the Government, and are kept extremely busy filling orders for their well known "HABIRSHAW" brands of insulated wire. Visitors are always welcome at headquarters, 15 Cortlandt street.

The October 13th edition of the BROOKLYN DAILY EAGLE contained an account of the death of Charles Delos Doubleday, of Brooklyn, an electrician. The item caused a great deal of sorrow among the numerous friends of C. D. Doubleday, the well known supply man of Manhattan, they being under the impression that it was he who had passed into the land of shades. We desire to assure the friends of the Manhattan Doubleday that he is still one of us, as hearty and robust as ever, and any one calling at his office at 137 East 33d street, Manhattan, will receive a welcome which will leave no doubt in his mind as to the present status of C. D. Doubleday, of Manhattan.

WESTON STANDARD ILLUMINATED DIAL STATION INSTRUMENTS.

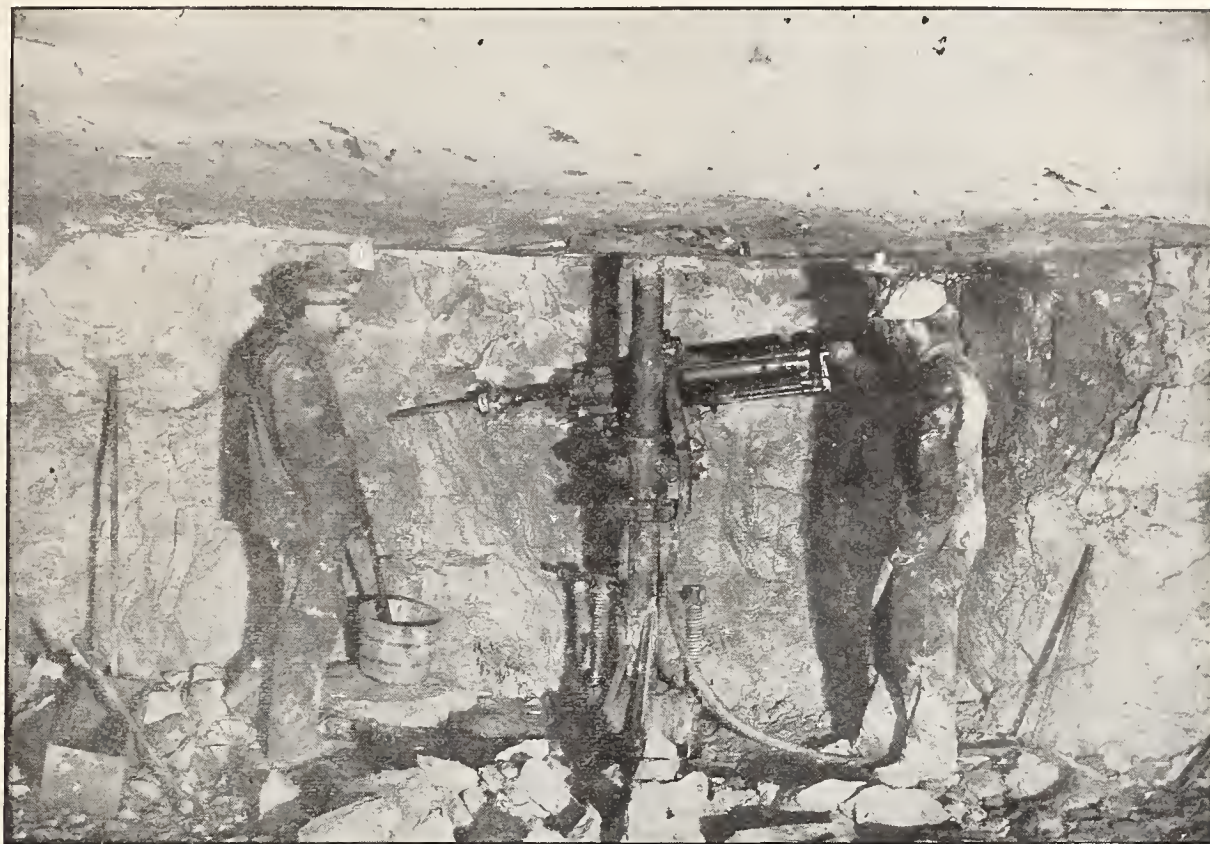


THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

ELECTRIC MINING.



Marvin Drill Underground.



Marvin Drill Mounted on Tripod.

ELECTRIC ROCK DRILLS.

The inception and growth of the electric drill has been of sufficient importance to excite considerable interest among mining engineers. The electric rock drill, a drill driven by electricity, has become an element in mining operations of considerable value. A highly perfected economical and durable electric drill is manufactured by the Marvin Electric Drill Company, of Canastota, N. Y. A great deal of steady care and experiment has been devoted to the perfection of the Marvin electric rock drill. The problem is not a very simple one, but we can state, with considerable pleasure, that it has been solved to the

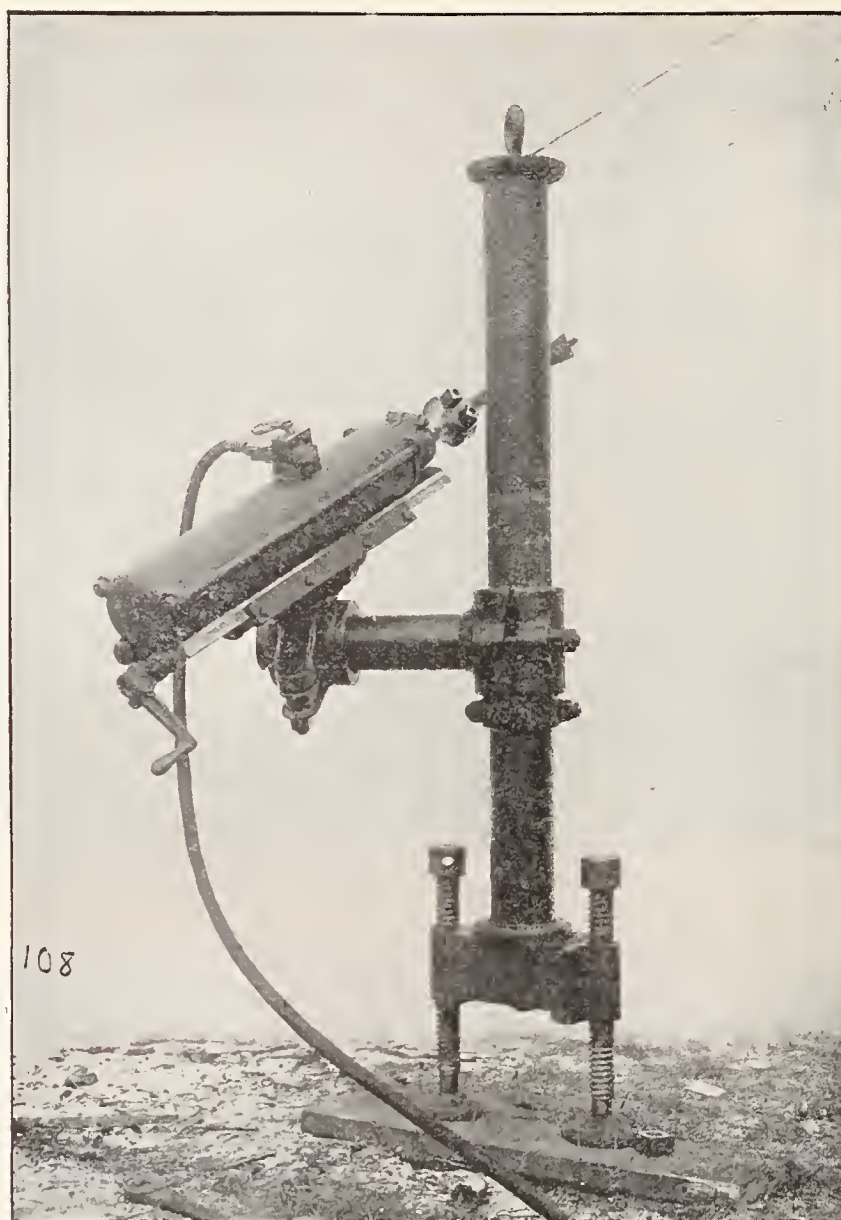
satisfaction of many mining experts, by the above concern. In tunnel and quarry work a class of mining is met with that puts to the severest tests any rock drill, whether operated by steam, compressed air, or electricity.

The fact that a successful rock drill must be simple, strong and economical, is a common-sense conclusion that would be arrived at from a most casual review of the circumstances, but the demand is most emphatic on the part of mining engineers that an electric drill shall be cheap to operate and inexpensive to maintain.

The "Mining & Metallurgical Journal" speaks most

intelligently upon the subject of electric rock drills in mining, as follows: "those who have watched the development of electrical engineering will realize that today electrical apparatus is turned out which embodies the most rugged mechanical design and high electrical effi-

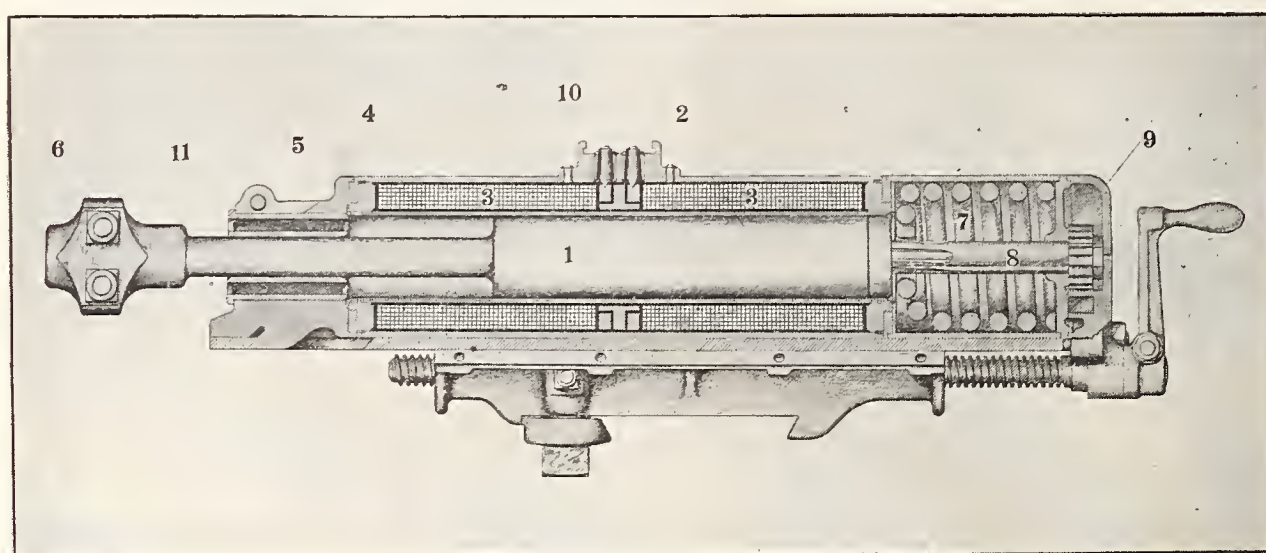
electric wires present none of the difficulties encountered in running a pipe line or moving a boiler from point to point as the work changes; and moreover, the wires may be quickly shifted or extended inexpensively as the work changes.



Marvin Drill Mounted on Column.

ciency. Electricity lends itself especially to power transmission, owing to the readiness with which the wires can be strung and the small cost necessary. The advantages of an electric system over any other mode of power trans-

Referring to Figure 1, showing the section of a Marvin electric drill, it will be observed that the construction of this machine is extremely simple. The main portion of the drill consists of a coiled body comprising two coils



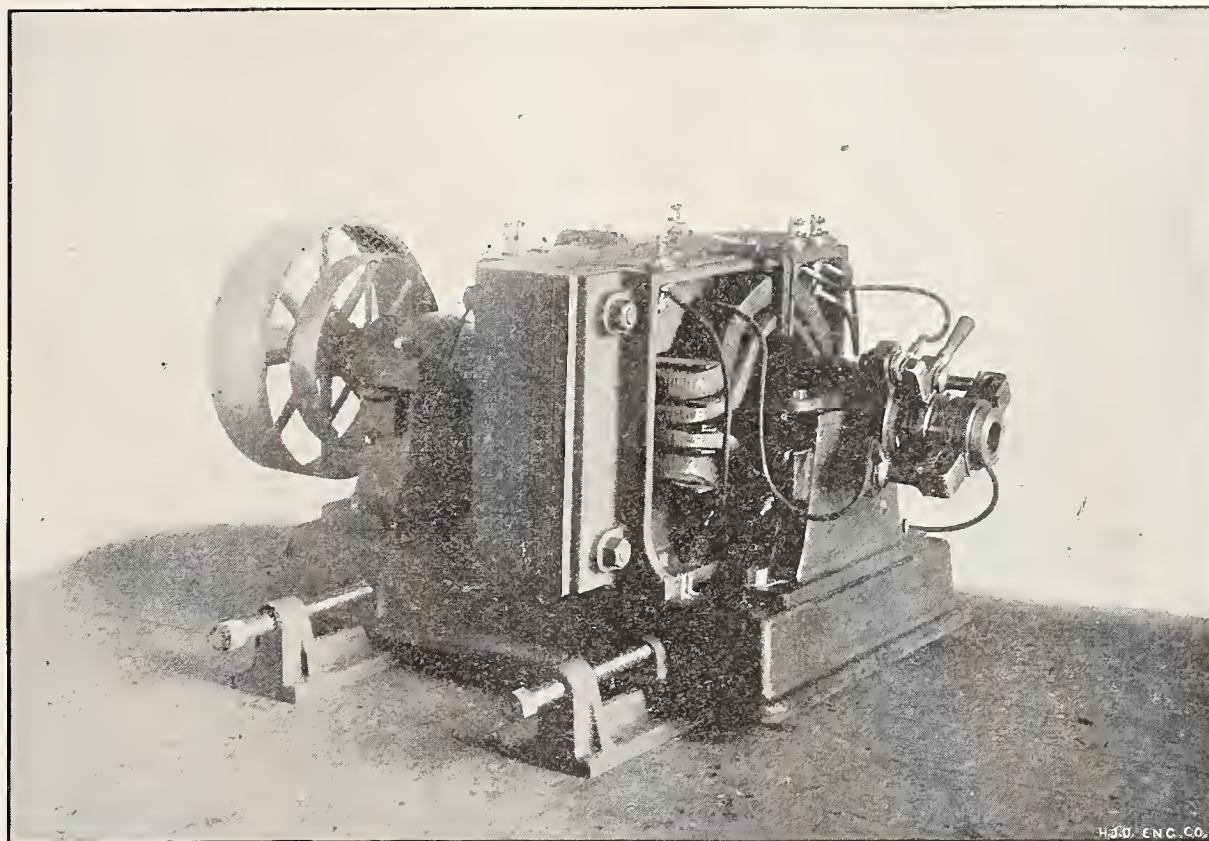
Sectional View of Marvin Drill.

mission is a commonly accepted fact. Wires may be strung in a most temporary manner and branch lines may be carried to distant points where the power is required without a large outlay of money and requiring practically no expense to keep in order. In prospecting work where it becomes necessary to convey the power a long distance, and across rough and mountainous country, the

of wire, 3 and 3, which form a double solenoid. Within this solenoid is developed the magnetic core, which actuates a soft steel plunger moving it to and fro as steam affects the piston in steam drill. The plunger is a soft steel forging reduced in section throughout one portion and at the end is formed a massive chuck to receive the bit. The plunger is indestructible and will withstand the

shock of the blow without breakage or crystallization. The coils are wound with square copper wire and insulated between layers and turns with pure India mica, thus rendering the coils mechanically indestructible and fire-proof in case they receive more current than represents their normal capacity. These coils are encased in an iron jacket, which is caulked to the heads of the coil, thus

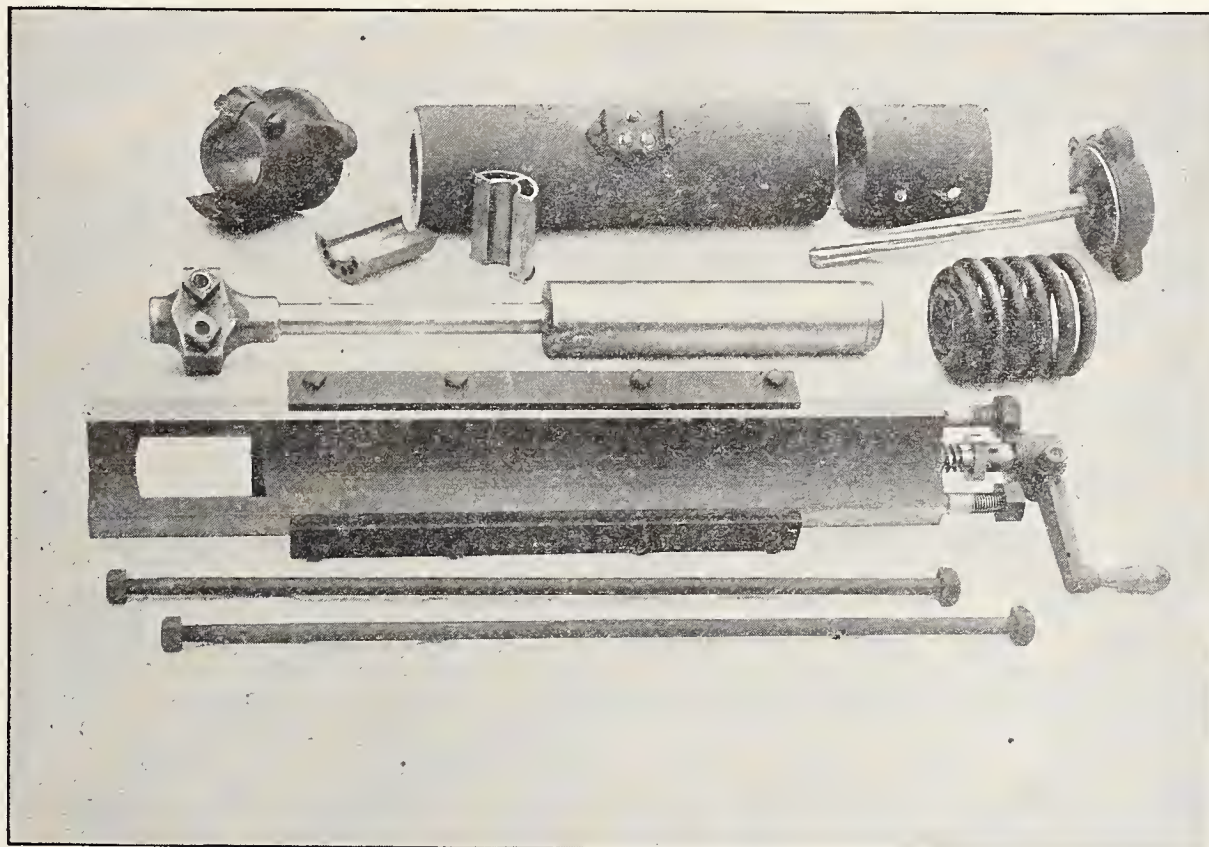
"By referring to Figure 2, showing the drill pulled apart, it will be observed that the different parts of the drill interlock and are held together by two side bolts and two studs, the latter being integral with the concaved slide upon which the different parts are held. The generator shown by Figure 2, for operating the drills, is an extremely simple machine, being so designed that it can



Marvin Drill Generator.

making the coil absolutely water-tight. The current is directed into the two coils in alternation by the generator itself, thus doing away with anything in the nature of a valve or switch on the drill. The backward stroke of the plunger is checked by the buffing spring No. 7 which

be taken down and packed into boxes not exceeding three hundred pounds each. This feature becomes necessary in order that the apparatus may be transported on mule back. Three wires are carried from the generator to the centre of the working area, where branch lines may be



Marvin Drill Pulled Apart.

returns the energy momentarily stored in the spring to the forward stroke. The turning of the plunger is affected by a rifled bar and ratchet device in the back head similar to that used in other drills. All parts of the drill are equally strong, and in the hands of the most ignorant man no damage can be done to the machine. The wearing parts can be easily and cheaply renewed.

led to the different drills. The drills operate independently of one another, and the generator regulates the voltage so that each drill will receive the proper amount of current."

In Figure 4 the six-inch drill is shown mounted on an adjustable column for tunnel or general underground work. In Figure 5 the six-inch drill is represented in

actual operation underground. In Figure 6 the seven-inch drill is shown on tripod mounting.

This condensed description covers the most prominent features of the Marvin electric rock drill, the success of which has been so pronounced as to leave no doubt whatsoever of their general employment for the purpose outlined in practical mining operations.

ELECTRIC LIGHT AND POWER.

SEARCH-LIGHT ATTACHMENT TO LOCOMOTIVE HEAD LIGHTS.

Through the courtesy of the "American Engineer, Car Builder and Railroad Journal.")

An arrangement for turning locomotive headlights on a vertical axis for the purpose of throwing the light upon the tracks on curves, designed and patented by Mr. John S. Thurman, mechanical engineer of the Missouri Pacific Railway, is illustrated in the accompanying engraving. The drawing shows an electric head light with a motor and dynamo mounted together on a table, on the under

ANOTHER INJUNCTION IN FAVOR OF THE MARKS ENCLOSED ARC LAMP.

The injunction issued October 18, 1898, by Judge Coxe, restraining the Washington Mills Company, New York, from infringing the Marks-Ransom enclosed arc method patent, and the permanent injunction issued November 5, by Judge Lacombe, against the Electric Construction Supply Company, manufacturers of the Kinsman lamp, has been held to apply to the enclosed arc lamps manufactured by the General Electric Company. By the order of the court 40 of this company's enclosed arc lamps **have** been removed from the factory of the Washington Company, Lawrence, Mass., and other lamps of the same type, but licensed under the Marks patents by the Marks Enclosed Arc Light Company, are now being substituted. It is held that the General Electric lamps infringe the Marks-Ransom patent, and are enjoined under clause 4 of the Kinsman injunction decree, issued November 5, 1898.

The Enclosed Arc Light Co., 120 Liberty street, city,

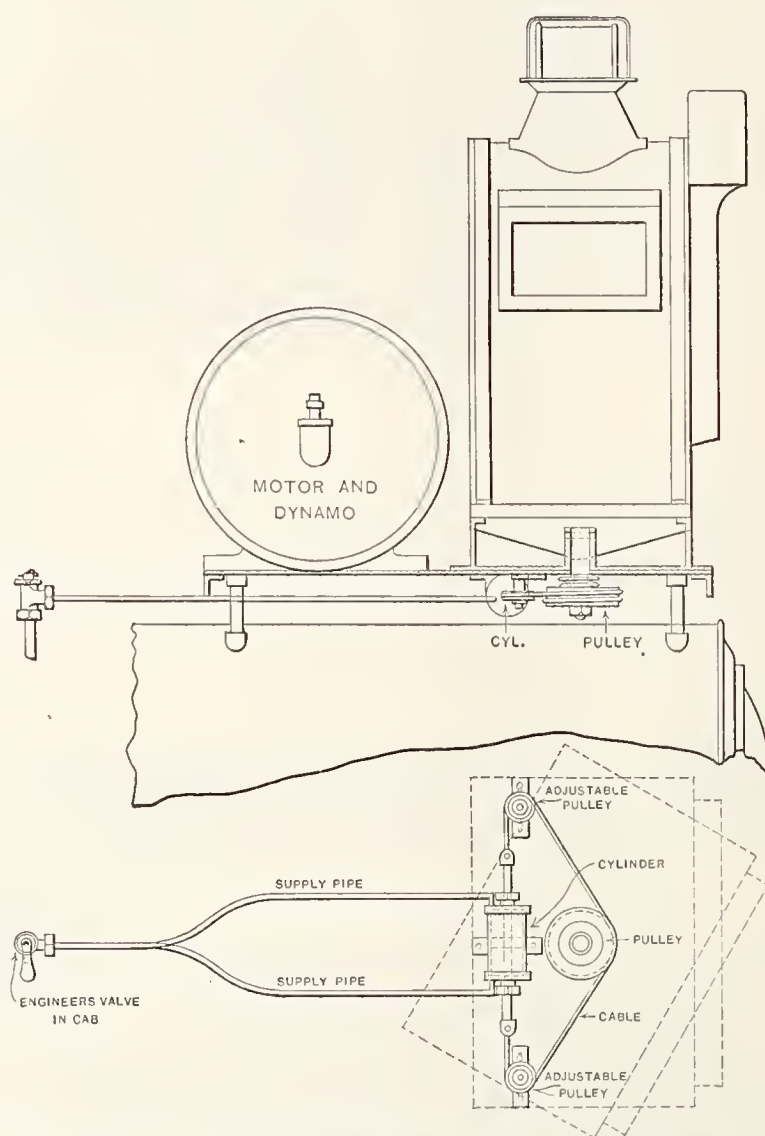


Diagram of Search Light Attachment to Locomotive Head Lights.

side of which the turning mechanism is secured. The headlight is mounted on a turn-table, which is rotated through the proper angle by a cable passing around pulley and leading to the two piston rods of a two-and-one quarter-inch double-acting air cylinder.

The motion of the piston is regulated by a valve in the cab, the air pressure being taken from the air-brake system. The surface on which the headlight turns is in the form of inclines, so arranged that when the headlight travels up the incline it will have bearings on the two quarters on which it travels. The object of this is to return the headlight to its normal position automatically when the air is released. The device has been tried on three western roads and the engine men like it. They say that they can see ahead as well on curves as on straight tracks. It is equally well adapted to headlights using oil.

the Manhattan General Construction, 111 Broadway, and the General Incandescent Arc Light Co., 1st avenue and 33d street, New York City, are licensed by the Marks Enclosed Arc Light Co.

Franklin, Pa.—The Franklin Steel Casting Company is installing an electric light plant in its power house.

Independence, Mo.—A franchise for the erection of an electric light and ice plant has been applied for by W. T. Felton, of Kansas City, Mo.

Fredericksburg, Va.—Address the Mayor regarding estimates which are to be obtained on the construction of electric lighting plant.

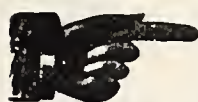
Clarence, Mo.—Five thousand dollars have been voted for an electric light plant.

The Electrical Age.

ESTABLISHED 1883.

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NEW YORK, NOVEMBER 19, 1898.

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THE INCREASING USE OF ALUMINUM.

Tradition sometimes tells us in her old-fashioned, feeble way that aluminum is not so new that this century has seen the first of it. It might have been better for us had it been an older metal, industrially, but in view of the fact that it is a new product produced by a new power, it possesses an interest for us which makes each new application of this strange white metal the subject of continued remark. The future of aluminum is slowly unveiling itself. In the field of applied electricity electricians have discovered a direct gain in its use as an electrical conductor. The possibilities in store for it are correspondingly great in the building trade, but it seems as though its greatest success will be found only when alloyed with other metals. Aluminum alloys have properties which render aluminum in this state, and acting as the preponderating element, a metal that has tremendous advantages over the alloys of brass and such an unsatisfactory metal as cast iron.

One of the most remarkable properties of aluminum is that it renders certain alloys more fluid at lower temperatures than either gun metal, for instance, or other brass mixtures. Mitis metal, which possesses high permeability, is practically a slight alloy of aluminum and cast iron. It is supposed that aluminum acts as a flux for certain foreign elements in the crude cast iron, thereby giving

a nature and consistency to the remaining metal which makes it approach in appearance and strength wrought iron. The use of aluminum, therefore, in conjunction with other metals is not new in this profession, although it has never met with any broad applications.

A new product called aluminum brass stands a strain of thirty thousand pounds per square inch as its elastic limit. This may be improved upon sufficiently to reach forty or fifty thousand pounds, the degree of elongation not exceeding three per cent. The advantage of improving upon aluminum alloys sufficiently to make them possess great tensile strength and comparative lightness is self-evident to those entrusted with the erection of an extensive transmission plant. The cost of erecting a long line depends largely upon the weight of the conductor to be supported upon insulators. In this respect aluminum, while not at present superior to copper, still holds its own sufficiently to be utilized for power lines miles in length. The non-corrosibility of aluminum is a large item in its favor. In tropical countries, particularly during the rainy season, the corrosion of copper wires is most marked, and it seems likely that the substitution of aluminum wire in its place might in some few installations be of decided benefit.

The aluminum of today is a characteristic electric product, as are carborundum and carbide of calcium. The industrial value of these three is increasing year by year, and as our horizon increases we see more clearly the great benefits civilization has already derived from these important advances.

PATENT LAW IN AUSTRIA.

On the seventh of January, 1899, the new patent law of Austria prevails. It is based on the German law through which a patent must pass a body of experts or board of examiners empowered to grant or refuse a patent. This puts considerable arbitrary power into the hands of those entrusted with this great responsibility, and it is to be hoped that they will never cease to regard a public office as a public trust. Under the new law of Austria patents are granted for a term of sixteen years on inventions which relate to the industrial arts, and unless in the line of medicaments, foods, chemical products which which have caused to be originated new processes, a patent grant is not possible. One peculiar phase of the Austrian patent law is that which gives the government or war officials freedom to use new devices in the line of armament, war vessels, ammunition, and to pay for such whatever is deemed in their judgment a fitting value. The patent office may also grant licenses even in cases where the patentee objects. In many respects the power of the patent office has been greatly increased, but at the same time no evil consequences will result from this further extension of power if able men are selected whose judgment will be in all cases perfectly unbiassed.

THE RUBBER INDUSTRY.

To quote from our esteemed contemporary, "The Trade Journals' Review," we find that the United States has done exceedingly well in rubber. The increase in output has gone up from twenty-five to fifty per cent. This has been explained by the increased demand for bicycle tires and rubber-covered wire. A new material, called textiloid, a substitute for rubber, has been invented and introduced by Eugene Cadret, of Paris. Its chief ingredient is oil. Textiloid, before being marketed, is exposed to a pressure of from two hundred to three hundred atmospheres. Very little, however, has been said of its electrical properties.

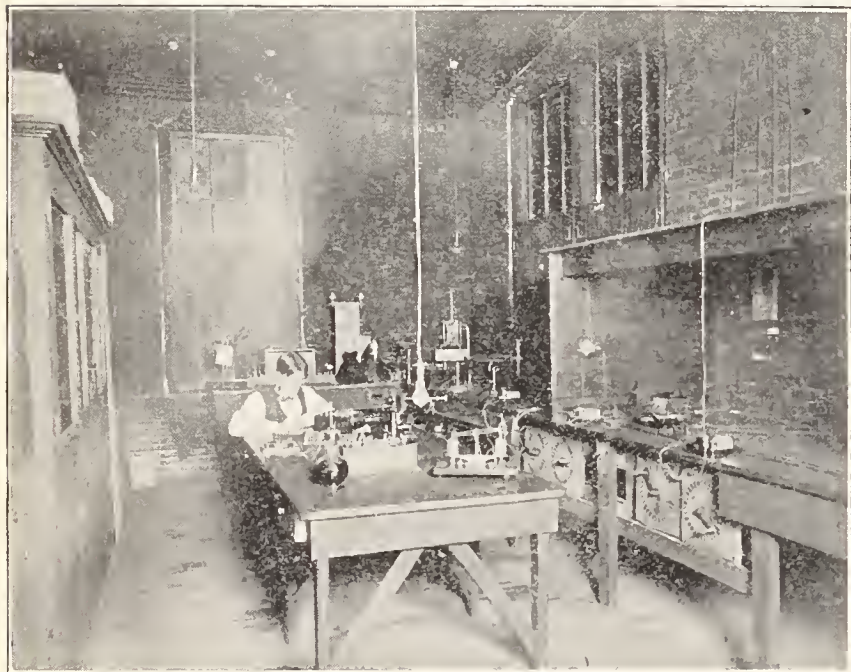
INCANDESCENT LAMP MANUFACTURE.

THE MANUFACTURE OF MODERN INCANDESCENT LAMPS.

The features that constitute a good incandescent lamp and which must be taken into consideration by the purchaser are long life and high efficiency. In many cases efficiency is secured at the expense of durability, and it is only when both of these qualities exist that a lamp may be said to be a commercial success. To manufacture an incandescent lamp appears on the face of it to be a comparatively simple process, but in detailed development

article for the purpose of showing the processes through which the Shelby lamp passes. One of its particular features is the shape of the stem supporting the filament. Another is the complete absence, due to special construction, of the so-called "Edison" effect. Another, and not least important, is the remarkable properties of the filament. In this respect the company claim a knowledge of the art of lamp making far in advance of that possessed by others.

The materials of which the filaments are composed are kept secret, but the shaping, coiling into three loops, etc., may be viewed by any other visitor to their establishment. The stem of the Shelby lamp is of U shape. This absolutely prevents any possibility of short circuit to the



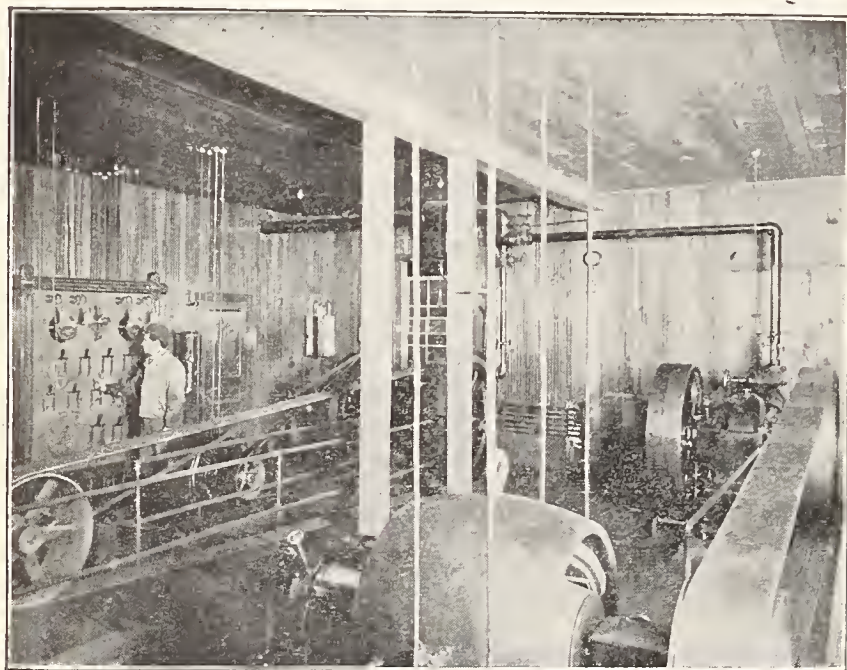
One End of Physical Laboratory, Shelby Electric Co.



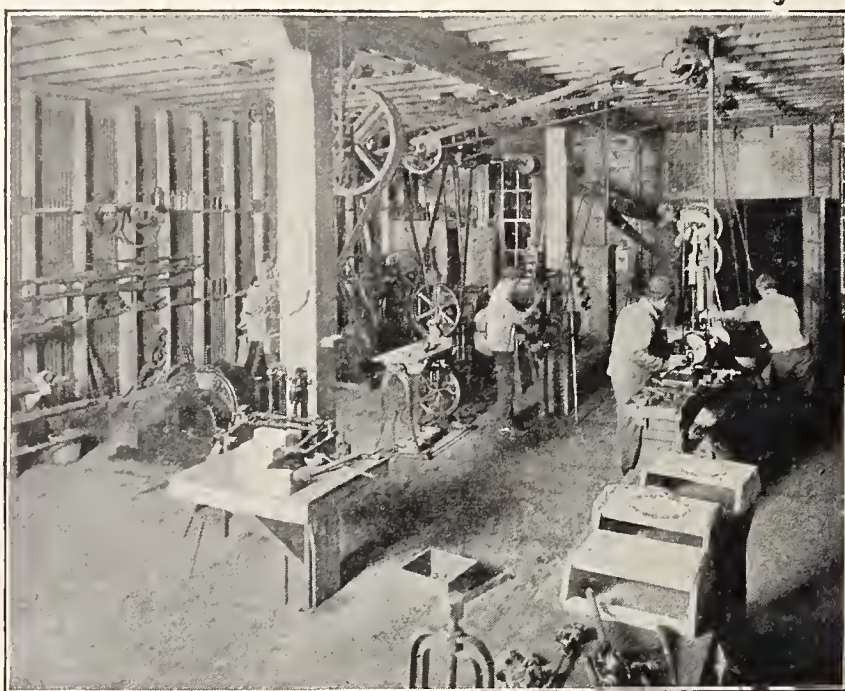
One End of Chemical Laboratory, Shelby Electric Co.

and long list of precautions there are few, if any, manufactured articles that require more delicate attention. In 1896 the Shelby Electric Company was organized by a number of wealthy financiers. The object of this con-

terminals. The joint between the stem and base is absolutely moisture-proof; the leading-in wires by the completeness of their insulation destroy all possibility of the "Edison" effect occurring, referred to above. The ef-



Corner in the Engine Room, Shelby Electric Co.

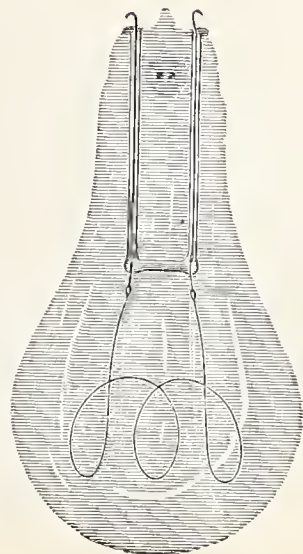
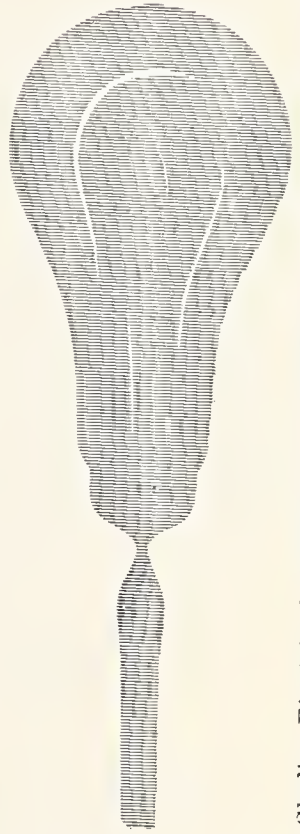
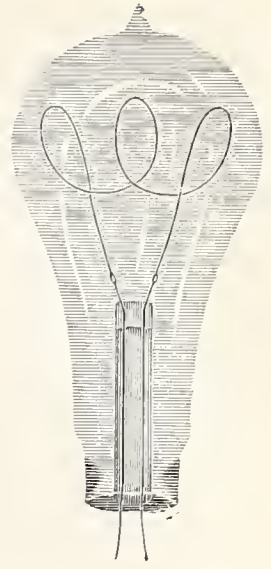
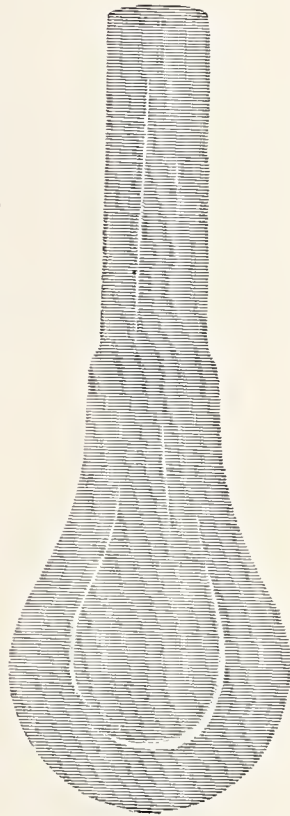
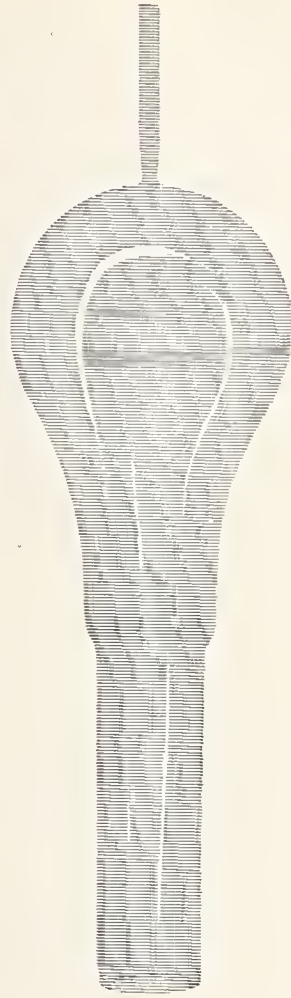
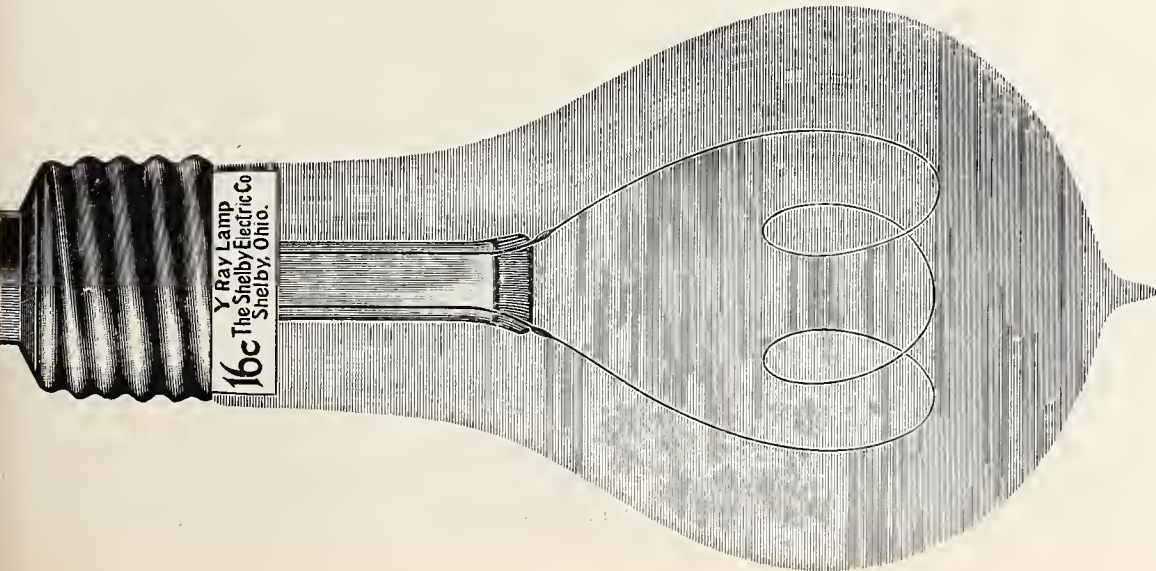
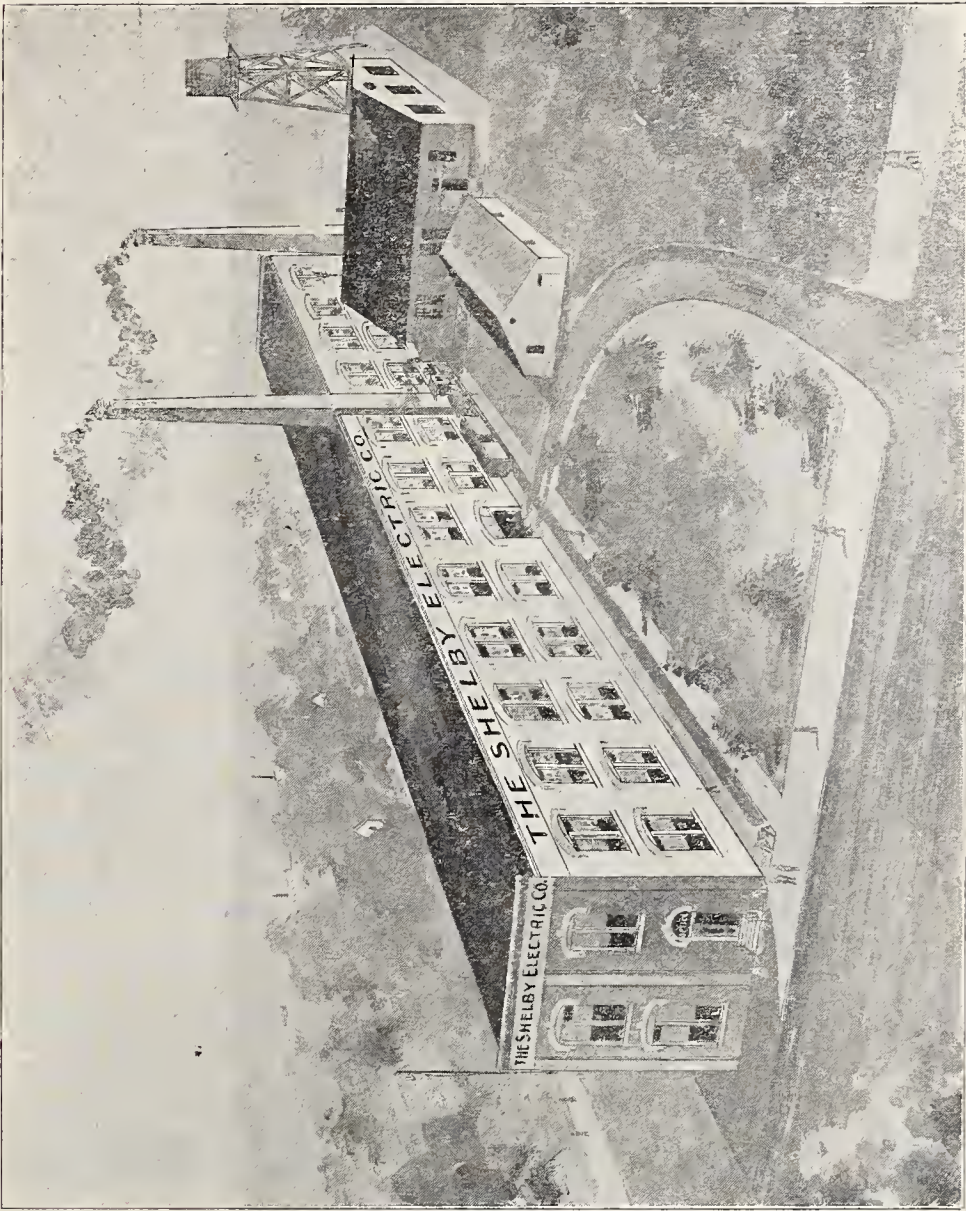
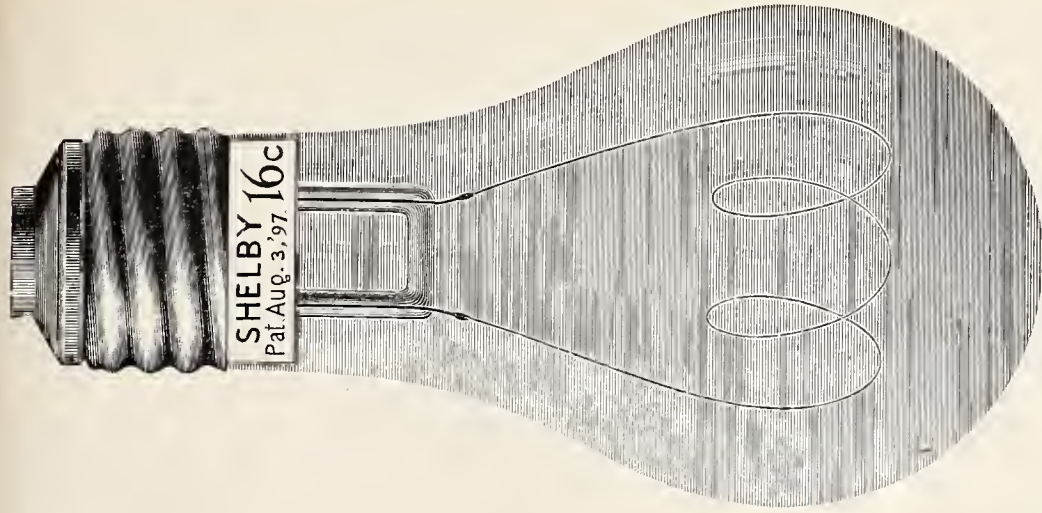


Corner in the Machine Shop, Shelby Electric Co.

cern was the manufacture of a high-class incandescent lamp built upon such lines as those demonstrated to the incorporators by Prof. A. Chaillet. This company was organized with a capital stock of \$100,000, with but one object in view, to produce a lamp of superior qualities, whose hold upon the consumer would be sufficiently strong to make it unique among its competitors.

A series of illustrations have been appended to this

fective separation of the leading-in wires is more advantageous than is generally supposed. No better proof of the modern construction of this lamp can be brought forward than the fact that it is tipless. The bulb is continuous and perfectly spherical at the end where the tip is generally found in other makes. This is a decided advantage and indicates a close study of the details of construction and design. Appreciation of this is shown by a de-



The Shelby Electric Company's Lamp Factory, Its Processes and Products.

mand exceeding 5,000 lamps a day, which will lead in the near future to a radical increase in the size of the factory.

The sketches of the different conditions of the lamp bulb may be further interpreted by the following: When the bulb is ready for the lamp maker it is washed and dried by means of an air blast. The stem containing filament is fused in. The quadrilateral shape of the support holding the filament and carrying the terminals gives the lamp an up-to-date and business-like appearance. After sealing the stem into the lamp, niches are made in the neck for the purpose of having the plaster adhere not only by surface contact, but by a species of dovetail. The testing of the lamps is interesting in so far as they are taken into a dark room and exposed to the terminals of an induction coil of thousands of volts' pressure for the purpose of determining the degree of vacuum they possess. Unless the vacuum is "dead black," as the technical phrase goes, which condition is determined by the glow, the lamps are exhausted still further.

Nearly every lamp turned out by the Shelby Electric Company can be used as standard. The variation in candle power, pressure and wattage of one or the other is so slight as to make the difference negligible. The candle-power test of each lamp, the vacuum test, and the ultimate packing of the lamps for shipment represent phases in the history of Shelby lamps which are very instructive and deeply interesting.

The company has met with remarkable success, and it may be said that it is as much due to the high perfection the lamp has reached in their hands as to the clockwork-like system prevailing in their factory. It seems as though one goes hand in hand with the other, and that success in manufacturing depends entirely upon the closest attention to these two factors.

The Shelby factory is at Shelby, O. About one hundred and eighty employes occupy the premises, which are two hundred feet long and sixty-four feet wide. Many girls are used in their factory, their lightness of touch and skill in certain departments of the work making them the best help obtainable. The office force of the company is connected by a private telephone system. The scientific department is in the hands of trained chemists, experienced engineers and first-class electricians.

A COMMUNICATION FROM NIKOLA TESLA.

NEW YORK, Nov. 18th, 1898.
46-48 E. Houston street.

EDITOR OF THE ELECTRICAL ENGINEER,
120 Liberty street,
New York City.

SIR:—

By publishing in your columns of November 17th my recent contribution to the Electro-Therapeutic Society you have finally succeeded—after many vain attempts made during a number of years—in causing me a serious injury. It has cost me great pains to write that paper, and I have expected to see it appear among other dignified contributions of its kind, and, I confess, the wound is deep. But you will have no opportunity for inflicting a similar one, as I propose to take better care of my papers in the future. In what manner you have secured this one in advance of other electrical periodicals, who had an equal right to the same, rests with the secretary of the Society to explain.

Your editorial comment would not concern me in the least were it not my duty to take note of it. On more than one occasion you have offended me, but in my qualities both as Christian and philosopher I have always forgiven you and have only pitied you for your errors. This time, though, your offence is graver than the previous ones, for you have dared to cast a shadow on my honor.

No doubt you must have in your possession, from the illustrious men whom you quote, tangible proofs in support of your statement reflecting on my honesty. Being a bearer of great honors from a number of American universities, it is my duty, in view of the slur thus cast upon them, to exact from you that in your next issue you produce these, together with this letter, which, in justice to myself, I am forwarding to other electrical journals. In the absence of such proofs, which would put me in the position to seek redress elsewhere, I require that, together with the preceding, you publish instead a complete and humble apology for your insulting remark, which reflects on me as well as on those who honor me.

On this condition I will again forgive you, but I would advise you to limit yourself in your future attacks to statements for which you are not liable to be punished by law.

(Signed) N. TESLA.

STRAY CURRENTS.

THE IDEAL POWER STATION.

Mr. W. H. Preece read a paper before the Incorporated Association of Municipal and County Engineers at Yarmouth, in which he calls attention to the abuse of the power station. He says the great tendency to multiply power houses arises from (1) want of foresight in predicting the growth of electric industries; (2) economy in selecting land we have rather than pay money for land more suitable by position, but which we have not; (3) the restriction of legislation in confining operations to a defined area; (4) the growth of other industries side by side, especially tramways and railroads worked by electric traction. He also points out that if a plant—say 10,000 k. w.—working at its minimum load on the average three hours a day produces electrical energy at one penny per unit, it will do so at three farthings per unit if it works six hours, one half-penny per unit if it works 12 hours a day, and less than a farthing per unit if it works twenty-four hours a day. One large station conveniently built on the waterside, where coal can be delivered alongside, by rail or sea, at its cheapest; where water is abundant and available for condensing; where ashes, clinkers and dirt are easily barged away; where we have our control and our staff, is clearly the ideal power house for economy.

A NEW ARC LAMP.

We have been hearing a great deal of late about a novelty in arc lamps. Patents for this kind of lamp have been numerous enough, but it is questionable if there has been anything essentially new in the mechanism of arc lamps for many years. The "Electrical Review," of July 1st, fails to see any novelty in that lamp which has been so much extolled by many of the technical journals lately. Like many other arc lamps, it is regulated by a brake and wheel. No doubt it will work as well as all previous lamps of the same kind and construction, but our contemporary thinks it has nothing specially to recommend it before those already well known to purchasers and electrical engineers. The chief advantage claimed for it is that it will be cheaper to make, and presumably to sell, than other arc lamps. If this were true, and any practical advantage could be shown, a demand for them might be expected. There may be something new in attaching the globe of an arc lamp to dashpots, the advantage claimed being that the lamp globe can be raised and lowered by one hand. Of course, that is an obvious advantage in cases where a one-handed lamp-trimmer is employed; but these cases are not numerous enough to promise large dividends. The invention most wanted at present by lamp makers is one to enable them to sell the lamps.

ELECTRICITY**IN****JAPAN.**

In a recent lecture at New York on this subject, Professor I. Fujika stated that the telegraphic system in Japan, which is controlled by the Government, comprises 12,000 miles of land lines and 388 of submarine cables, besides the cable to Formosa, some 800 miles long. The number of messages sent in a year exceeds 22,250,000, while the traffic with foreign countries reaches 150,000 despatches. The telephone is steadily growing in favor. The first exchange was opened in 1890, and in 1896 there were 540 miles of lines and 3,232 subscribers. Nearly all the larger cities and towns are lighted by electricity, and in Tokio alone there are more than 50,000 lights. The construction of electric street railways has not kept pace with the development in other branches of electrical industry. In Tokio, which has a population of 1,500,000, there are only two working. Although 30 companies recently arranged to take out charters, only two were granted licenses to carry on business. These, however, when their lines are completed, will add an aggregate of 400 miles to the existing tracks.—Ex.

MICROPHONES**SUBMARINE****TELEGRAPHY.**

Experiments carried on at Cherbourg on behalf of the Marine Department are said to demonstrate that the pivot microphone is well suited for this purpose. The microphone consists of a carbon disk fixed at the centre of the diaphragm. A number of pivot elements are arranged around the disk. Each consists of a movable part and a little counterweight for regulating the pressure. The pivot is surrounded by a little mercury, which always allows the current to pass without interfering with the free motion of the carbons. This description is not very clear, and nothing is said concerning the way in which the experiments were conducted.—Ex.

CLARIFICATION**BY THE****ELECTRIC CURRENT.**

Walther Spring, the well known scientist of Liège, has addressed a preliminary communication on this subject to the "Chemiker Zeitung." Spring has tried the electric current. When the liquid contains no salts in solution, but only silica, clay, peat, etc., a high electromotive force from 8 to 16 volts is required, as the resistance of the bath is high; in presence of electrolytes, 2 volts will suffice. Spring points out that whenever adhesion is weakened or destroyed, electricity is generated. The fine particles of some emulsions are prevented from coalescing by their electric condition. Electrification causes aggregation and settlement, and the sunlight and heating accelerate the clarification because they give rise to convection and concentration currents.—Ex.

THE**MEASUREMENT OF****ELECTRICITY.**

Mr. R. Blondlot, of Paris, recently read a paper on the direct measurement of electricity in electromagnetic units and its application to the construction of a current meter. A coil in the form of a ring is hung on a vertical axis inside a long horizontal bobbin, the same current passing round both coils. The product of the intensity of the current with the time of oscillation—that is, the quantity of electricity which traverses any given section of wire during one swing, is a constant quantity, depending only on the construction of the two bobbins. By the application of a device for counting the vibrations of the small coil, a practical coulomb meter is obtained, which works equally well with continuous and alternating currents.—Ex.

STRAY CURRENT MEASUREMENTS.

Mr. A. A. Knudson, in an article read before the American Institute of Electrical Engineers, entitled "An Electrical Survey in the Borough of Manhattan, New

York City," speaks of a series of tests he has made for electrolytic action due to open conduit and trolley roads. He speaks in favor of the open conduit system as causing little or no electrolysis. In his opinion the L road structures, Brooklyn Bridge terminals and the supports of steel frame buildings may be seriously affected in the course of time unless precautions are taken at once to prevent electrolytic action.

Legislation has already occurred in England in regard to this matter and it would seem as though similar municipal action would have its good effect. Mr. Knudson's paper teaches New Yorkers as well as the residents of other trolleyed cities a valuable lesson—one that may be acted upon at once for the avoidance of serious risks.

WIRELESS TELEGRAPHY.**SOME COMMENTS UPON WIRELESS TELEGRAPHY BY AN ENGLISH CONTEMPORARY.**

Our English contemporary, "The Electrical Engineer," of London, thus comments sarcastically upon the present excitement in England over Marconi's invention:

More Marconi.—The untechnical press find in the word "Marconi" an ample word to conjure with, and from the quantity of copy produced we cannot but conclude that the Marconi syndicate helps to keep up the supply. The latest is the rumor of wireless messages to France, and the "Daily Mail" understands that "the French authorities have given permission for signalling stations to be erected anywhere along the French coast, so the experiments will doubtless be put in hand without much delay." In spite of this, and the hope which scientists hold out that signals will be sent without wires from London to Cape Town, the shares of the Submarine Cable Company hold up in a wonderful way. We fancy that the hopes of a large and successful company flotation are the main cause of much of the vague and rosy information disseminated about Marconi. To quote Mr. W. H. Preece's recent address before the Institution of Civil Engineers: "Sensational experiments for booming a new financial enterprise are not processes that commend themselves to the institution. We want practical work and engineering progress."

CONDUCTORS.**ALUMINUM WIRE.**

Aluminum wire, says the "Electrical Engineer," will be used for the transmission line conveying 10,000 horsepower from Snoqualmie Falls to Seattle and Tacoma, Washington. Contracts have been made for the supply of the wire—150,000 lbs.—at prices that make it cheaper than copper for the purpose. The metal used will be nearly pure, being guaranteed to contain 99.30 per cent. of aluminum and not more than 0.25 per cent. of iron and 0.30 per cent. of silica. It will be alloyed with 1.50 per cent. of pure copper. This is the first large transmission to use aluminum, and marks an important step in electrical engineering; for while aluminum has been talked of for some time for this purpose, price or some other factor seems to have stood in the way of its practical use to any extent over long distances. For the first 20 miles the transmission lines will run over the same right of way. At Renton they separate, and one goes northwest about 12 miles to Seattle, while the other goes southwest about 27 miles to Tacoma. At Renton there will be facilities provided for switching the Seattle circuit on to the Tacoma circuit, and *vice versa*.

Paducah, Ky.—Henry Biedeman is organizing a company to install a telephone system.

TELEGRAPHY.

THE COMBINATION MORSE WATCH,

That is, a Morse-Watch combined with key, is exactly similar to the Morse-Watch with the addition of a thoroughly practical, platinum-pointed telegraph key mounted in the same case. With exception of knob, the whole key is inside the case. The knob is hard rubber mounted conveniently for work, but offers no obstruction to putting the watch into or removing it from the pocket. The "play" of key is adjustable by turning the knob, and turning the knob solidly home makes a positive circuit closer. The whole is neat, compact and workmanlike.

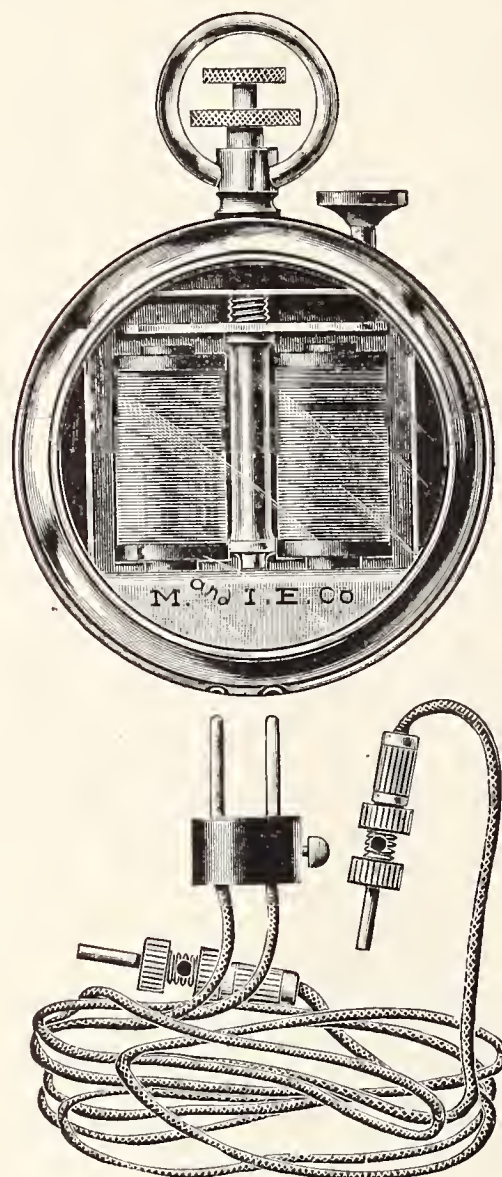
Identification.—Each instrument, "Morse-Watch" and "Combination Morse-Watch," is numbered individually.

tric Co., corner Fulton and William streets, New York, supply two small cells of dry battery in neat pocket form whenever ordered.

ELECTRO PLATING.

SOME POINTS ON GALVANIZING.

At a recent meeting of the London Society of Engineers a paper was read by Mr. Sherard Conzses-Coles, entitled "Protective Metallic Coverings for Iron and Steel." After pointing out the comparative corrodibility of iron and steel under varying conditions, and the importance of the subject now that steel, which corrodes more rapidly than iron, is so largely used for structural purposes and for building light craft, such as torpedo boats, gave some



In writing the manufacturers or dealers at any time with reference to any instrument in the purchaser's possession, invariably give the number of the instrument referred to, for its identification.

Weight and size.—As stated, the size of the Morse-Watch is the popular standard watch size No. 18. The weight of the whole equipment, watch, cords, tips, head-band and all, is $4\frac{1}{2}$ ozs., and goes packed in a space 1 inch deep, 2 inches wide and 3 inches long.

Uses.—For typewriters, train despatchers, railway stations, linemen, testmen, inspectors, bulletin operators, newspaper offices, brokers' offices, military telegraphs, signal service, police stations, election centres, clubs, hotels, and all very noisy locations where it is difficult to hear the ordinary sounder, and all locations where it is desirable to maintain either uninterrupted quiet or absolute secrecy of telegraphic communication.

When used with key it makes a fine pocket or practice instrument. For the latter purpose the M. & I. Elec-

interesting examples of cases where failures had occurred in engineering structures owing to the rapid corrosion of iron and steel. He stated that up to the present zinc had been found to be the most effective coating, which was due to the electro-chemical action set up between the steel and zinc. The author also explained that the electro-chemical action set up between two different metals made it necessary to carefully insulate copper sheathing from the steel hulls of ships, and rendered the direct application of copper valueless as a protecting coating to iron and steel. A short history of the galvanizing industry was then briefly given, together with details of the improvements that had been introduced from time to time. The method of cold galvanizing was then fully described, and the methods of preparing iron surfaces for receiving the coating of zinc. A description was also given of some improvements in the acid treatment and sand blasting for the removal of mill scale preparatory to zincing. The process of sand blasting was fully described. The sand-

blast apparatus consists of an air chamber and hopper into which the air is forced at a pressure of about five lbs., and projected through a soft rubber fitted with a steel nozzle. It was stated that the harder the surface the more vigorously the small particles of sand or shot attacked it. The question next dealt with was the cost and output of various galvanizing plants, and a description was given of a special apparatus for the treatment of wires and tubes. The author finally explained the best working conditions for electro-zincing, and gave a comparison of the actual and theoretical weight of zinc obtained for a given amount of electrical energy. In connection with the above we note the invention of a new method of galvanizing wire, by which the wire is coated without the necessity of unwinding the coils. The coils or bundles of wire are first cleansed by acid. The whole bundle is then dipped into the bath of melted spelter, and when it has received a thorough coating it is quickly dropped into the basket of a centrifugal machine. For small or light coils the machine may be already in motion, while for heavier wire it must be started after the wire is put in. The surplus coating is almost instantly thrown from the wire, and an excessive speed is not required. The machine is stopped, and the bundle of wire is removed as quickly as possible, and is jarred upon a block to prevent the wires from soldering together. Barbed wire has been successfully treated by the new process after it has been twisted into shape and formed into bundles. When wire is galvanized before being barbed and twisted much of the coating cracks and peels off, and the points quickly rust. Treated by the new process, the wire is said to be more durable. Wire cloth more than eight meshes to the inch cannot be galvanized by the old method, while by the new process cloth of any fineness may be coated, if the speed of rotation is increased according to the fineness.

AN AUSTRALIAN OPINION OF THE MONTAUK MULTIPHASE CABLE.

Extract of Article from the "Scientific Australian," of September 20th, 1898.—"A highly interesting and successful trial of a new fire alarm apparatus was recently given by the maker, Mr. E. H. Kirkby, of Nelson Place, Williamstown, at the head station of the Metropolitan Fire Brigade, Melbourne. The experiments proved that the apparatus fulfils all that Mr. Kirkby claims for it.

"The most interesting feature of the experiments, however, was a trial of the Montauk automatic fire alarm cable, a newly patented American idea. The main instrument was disconnected from the recording apparatus and placed in circuit with the Bouverie street station. A flame was applied to the covered cable for a few seconds and, being thermostatic throughout its length, it was at once set in action and registered a pre-arranged signal at Bouverie street. As a result the hose cart arrived at the head station in under 3½ minutes. This was convincing proof of the usefulness of this cable, in conjunction with Mr. Kirkby's instruments. Had this combination been in use in Elizabeth street, Melbourne, in which the recent great fire originated, there is no doubt but that it could have been confined to small limits. The experiments were under the control of Chief Stein and his highly efficient staff of officers, and were an unqualified success.

AMONG THE SOCIETIES.

NEW YORK ELECTRICAL SOCIETY.

The following were elected to membership at the meeting of November, 17, 1898.

Prof. J. Burkitt Webb, Stevens Institute, Hoboken, N. J.
Hubert Greaves Webb, Glen Ridge, N. J.

Henry V. Parsell, 31 E. 21st st., N. Y. City.
Joseph White Stickney, 76 Hicks st., Brooklyn, N. Y.
Augustus Treadwell, Jr., Electric Storage Battery Co., 20 Broad st., N. Y. City.
Morton Arendt, 42 W. 126th st., N. Y. City.
W. G. Burns, 423 W. 117th st., N. Y. City.
Theo. H. Joseph, 32 E. 74th st., N. Y. City.
Bernhardt Hoffman, N. Y. Telephone Co., 15 Dey st., N. Y. city.
W. I. Thompson, 136 Sumner ave., Newark, N. J.
Frank R. Wainwright, Chesley Electric Co., 20 Cortlandt st., N. Y. City.
Thomas J. Buckley, Tenaflly, N. J.
St. John P. Chilton, 11 W. 39th st., N. Y. city.
William Newton, Ryerson, Montclair, N. J.
Thomas J. Fay, Electrical Engineer School of Correspondence, 120 Liberty st., N. Y. City.
J. E. Woodbridge, Editor Electric World, 9 Murray st., N. Y. City.
Charles E. Dustin, Excelsior Electric Co., Brooklyn, N. Y.
Henry B. Cutter, 1112 Sansom st., Philadelphia, Pa.
Alexander McGill, 1190 Madison ave., N. Y. City.
Charles T. Child, Electrical Editor Engineering Magazine, 120 Liberty st., N. Y. City.
Lieutenant W. D. Weaver, American Electrician, 26 Cortlandt st., N. Y. City.
Dr. Louis Duncan, Empire Building, N. Y. City.
A. E. Clifford, American Electrician, 26 Cortlandt st., N. Y. City.
A. Stamm, Chesley Electric Co., 601 Newark st., Hoboken, N. J.
V. C. Gilpin, Cutter Elec. & Mfg. Co., 120 Liberty st., N. Y. City.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL ELECTRICAL EXPORTS FOR WEEK ENDING NOV. 15, 1898, \$80,281.00.

New York, N. Y. Nov. 15, 1898. The following exports of electrical material are from the port of New York for the week ending this date:

Argentine Republic—94 packages electrical material, \$4,105; 16 packages electrical machinery, \$1,319.
Antwerp—53 cases electrical material, \$2,149.
British West Indies—30 packages electrical material, \$568.
British Australia—93 packages electrical material, \$7,719.
Berlin—17 packages electrical material, \$789.
Cuba—433 packages electrical material, \$1,591.
Central America—9 cases electrical material, \$430.
Christiania—4 cases electrical material, \$300.
Copenhagen—4 cases electrical material, \$83.
Ecuador—8 cases electrical material, \$295.
Glasgow—15 cases electrical plates, \$300; 7 cases electrical material, \$462.
Genoa—10 cases electrical machinery, \$350; 1 case electrical material, \$111.
Hamburg—30 packages electrical material, \$6,458.
Havre—53 cases electrical machinery, \$3,162.
London—64 cases electrical machinery, \$6,560; 52 cases electrical material, \$13,208; 1 case electros, \$17.
Liverpool—89 cases electrical material, \$4,051; 26 cases electrical machinery, \$273.
Mexico—35 packages electrical material, \$1,354.
Marseilles—55 cases electrical material, \$2,525.
Manchester—6 cases electrical material, \$660.
Naples—109 cases electrical machinery, \$17,746.

Odessa—1 case electrical material, \$200.
 Porto Rico—1 case electros, \$10.
 Peru—12 packages electrical material, \$316.
 Southampton—1 case electrical material, \$50.
 Santo Domingo—76 packages electrical material, \$2,451.
 U. S. of Colombia—7 packages electrical material, \$88.
 Venezuela—5 cases electrical machinery, \$231.
 Wigan—1 case electro shells, \$300.
 Waterford—1 case electrical material, \$50.

POSSIBLE INSTALLATIONS.

Monroe, La.—The Mayor may be addressed regarding the electric light plant which is to be erected. At a recent election \$60,000 were voted toward the construction of water works and electric light plant.

Thibodeaux, La.—Address the Mayor regarding the electric light proposition in favor of which the city voted some time ago.

Gadsden, Ala.—The Alabama Light & Power Co. will erect a power plant for furnishing electric railway power; to cost about \$25,000.

Kissimmee, Fla.—An election will be held to vote upon granting a ten years' franchise to J. M. Bailey for erection of an electric light plant.

Timmons ville, S. C.—Estimates will be obtained for the construction of water works and electric light plant. Address D. H. Traxler, chairman of committee.

TELEPHONE CALLS.

Charlotte, N. C.—The Queen City Telephone Co. has been organized with the following officers: J. A. Helvin, president; A. G. Brenizer, treasurer; directors, J. A. Helvin, W. F. Steele, R. S. Cole, A. G. Brenizer, T. W. Hawkins, W. H. Steele, J. H. Gourley and T. C. Guthrie; a telephone system is now being constructed.

Mayo, Fla.—The Luraville & Suwanee River Telephone Co. has been incorporated by T. I. McIntosh, S. V. Hough, B. S. Fisher, W. H. Cox, L. T. Boatwright, M. C. Reinck, E. P. Groover, W. T. Dees and M. J. Bryan; capital stock, \$3,000; to build, purchase and own telephone lines in Lafayette, Hamilton and Suwanee Counties.

NEW INCORPORATIONS.

Cleveland, Ohio.—International Fac-Similigraph Co. has been incorporated; to manufacture devices for electrical transmission of photograph plates. Capital stock, \$25,000.

Macon, Mo.—The Trans-Mississippi Electric Light & Power Co. has been incorporated by F. W. Bles, J. F. Schaefer, of Kansas City, Mo., and C. E. Roel, of St. Joseph; capital stock, \$30,000; to establish and erect electric light and power stations.

Waco, Tex.—The Mutual Electric Company has been incorporated by W. S. Seley, S. W. Slayden, I. A. Goldstein and T. Migel; capital stock, \$10,000; to supply light and power.

STREET RAILWAY NEWS.

Miami, Fla.—A company will be organized to build an electric line from Miami to Lemon City.

Gadsden, Ala.—The power for the Gadsden & Attalia Union Railway will be furnished by the recently organized Alabama Light & Power Co. The line, which is eleven miles in length, will be rebuilt for the use of electric cars, contracts for which have been given out.

BUSINESS CHANCES.

Baltimore, Md.—There is a movement on foot to combine the Edison Electric Illuminating Co., the Brush Electric Co. and the Northern Electric Co. For further details address J. F. Morrison, manager, Northern Electric Co., 15 South street.

NEW YORK ITEMS.

WILLIAM LINDSAY, formerly with the Pierce Engineering Company, is now connected with the C. & C. Electric Company.

WILLIAM J. CLARK, the well-known manager of the railway department of the General Electric Company, has been requested by Secretary of War Alger to finish the report of the late Col. Waring regarding the sanitation of the principal cities in Cuba.

I. P. Frink, of 551 Pearl street, has published a new catalogue of reflectors, etc., which we would advise those interested in the subject to send for, as it is one of the most complete of the kind. A copy will be sent gratis upon request.

A. L. BOGART COMPANY, 123 Liberty street, have been obliged to double the capacity of their works and sale-rooms, due to increasing business.

F. H. BADGER, JR., and wife, formerly general manager of the Mont Morency Electric Power Company, of Quebec, Canada, is stopping at the Marlborough Hotel.

Mr. STAR, of John Star, Son & Company, Halifax, is stopping at the Imperial Hotel for a few days.

EFFECT OF TEMPERATURE UPON CONDUCTORS.

The investigation of the properties of bodies brought near the absolute zero temperature is certain to give results of extraordinary importance. Already platinum resistance thermometers are becoming useless, as the temperature of boiling hydrogen is but a few degrees from the point where the resistance of platinum would be practically nothing or the conductivity infinite.—Sir William Crookes.

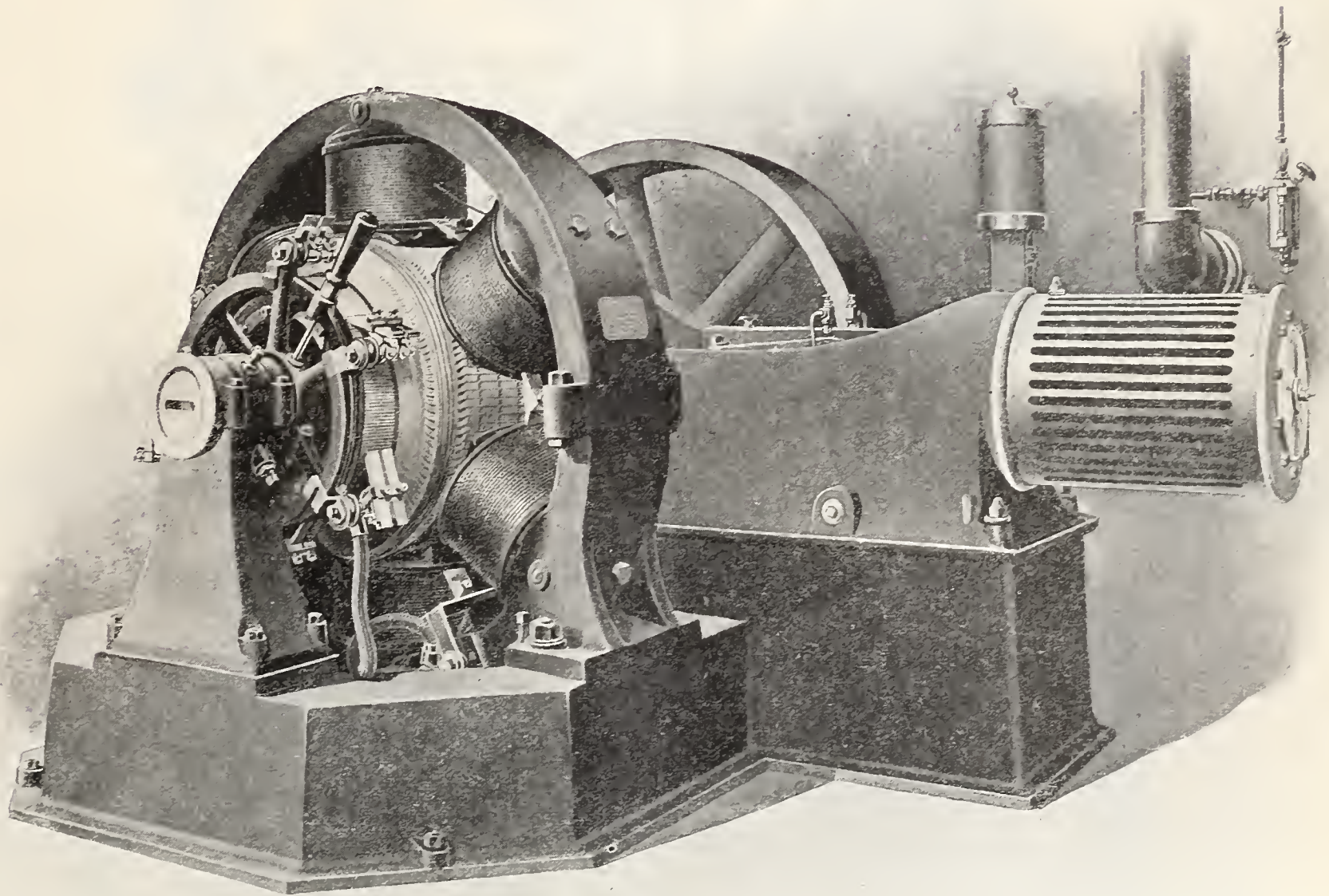


WESTON STANDARD
 PORTABLE DIRECT READING
VOLTMETERS AND WATTMETERS
 For Alternating and Direct Current Circuits.
 The only standard portable instrument of the type deserving this name.

Write for Circulars and Price Lists 8 and 9.

WESTON ELECTRICAL INSTRUMENT CO.
 114-120 WILLIAM STREET, NEWARK, N. J.

ELECTRIC LIGHT AND POWER.



Single Cylinder Engine, Direct Connected.

AUTOMATIC CUT-OFF ENGINES FOR ELECTRIC LIGHTING AND POWER PLANTS.

With the development of the dynamo, the engine received attention and underwent improvement such that it took its place as a factor as important as the dynamo itself in electric light and power plants. The design and construction of a successful engine for the above purposes calls for the closest attention to details which cover regulation, efficiency, expansion and other items which, collectively at their best, give issue to a modern engine. For electric light and street railway work, demands of the severest nature are made upon the motive power. It is absolutely necessary that an engine installed to perform its functions uninterruptedly should be one that has passed through a test which uplifts it above criticism. In other words, the modern engine, if it will succeed, must be made

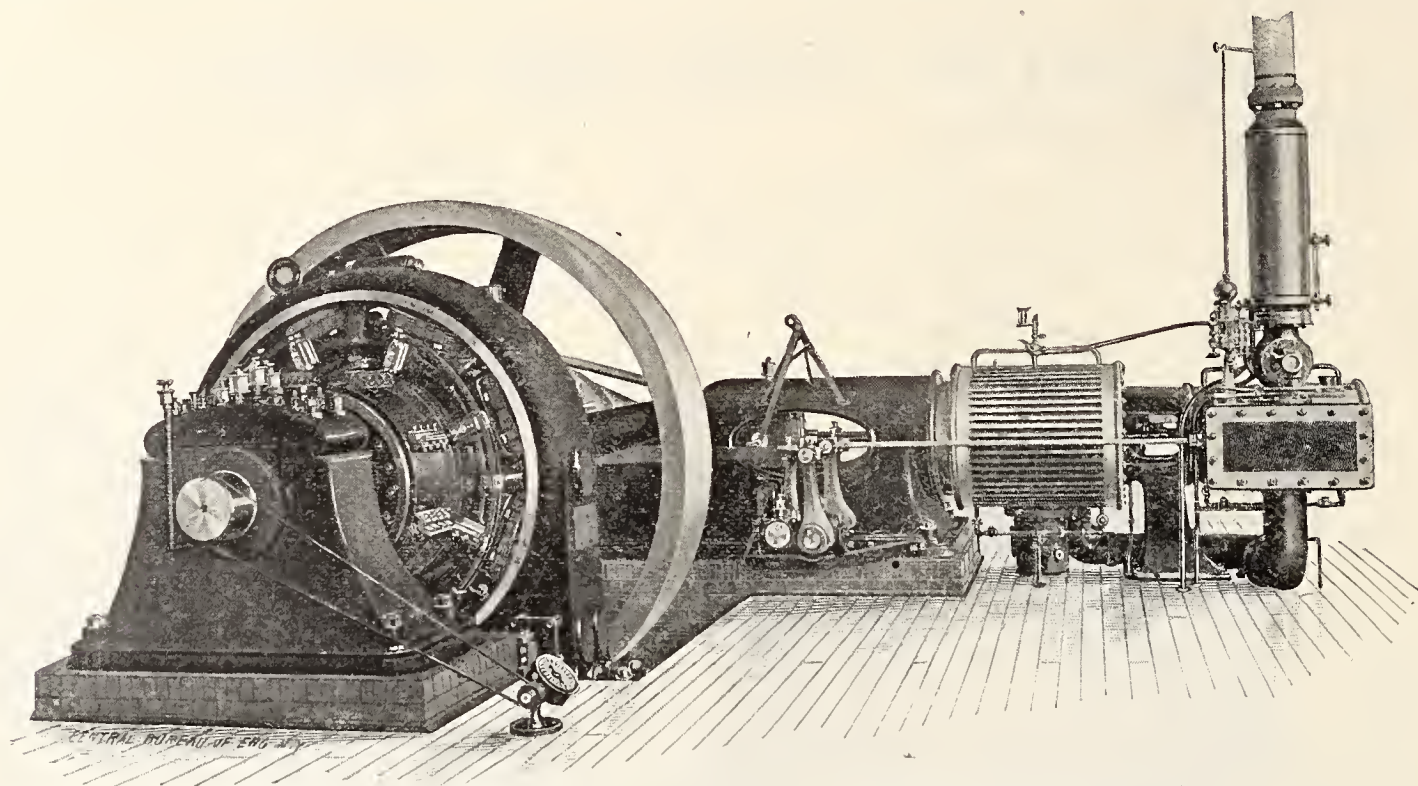
from the standpoint of quality, not cost, for herein lies its ultimate success.

The Ball Engine Company, of Erie, Pa., manufacture automatic cut-off engines for electric lighting, electric railway and general manufacturing plants. They have installed their engines, the government of which is unsurpassed in delicacy, in the new Congressional Library at Washington, a building within which everything should be of the best, and the new Public Library at Chicago.

The direct-connected plants driven by the Ball engine possess many advantages. But little floor space is required; there is little or no noise and no belting, the elimination of which means an enormous saving in power in the course of three or four years' service. Instead of there

being two widely separated machines to take care of, the dynamo and engine, there is practically one, the lubrication and care of which, though under constant super-

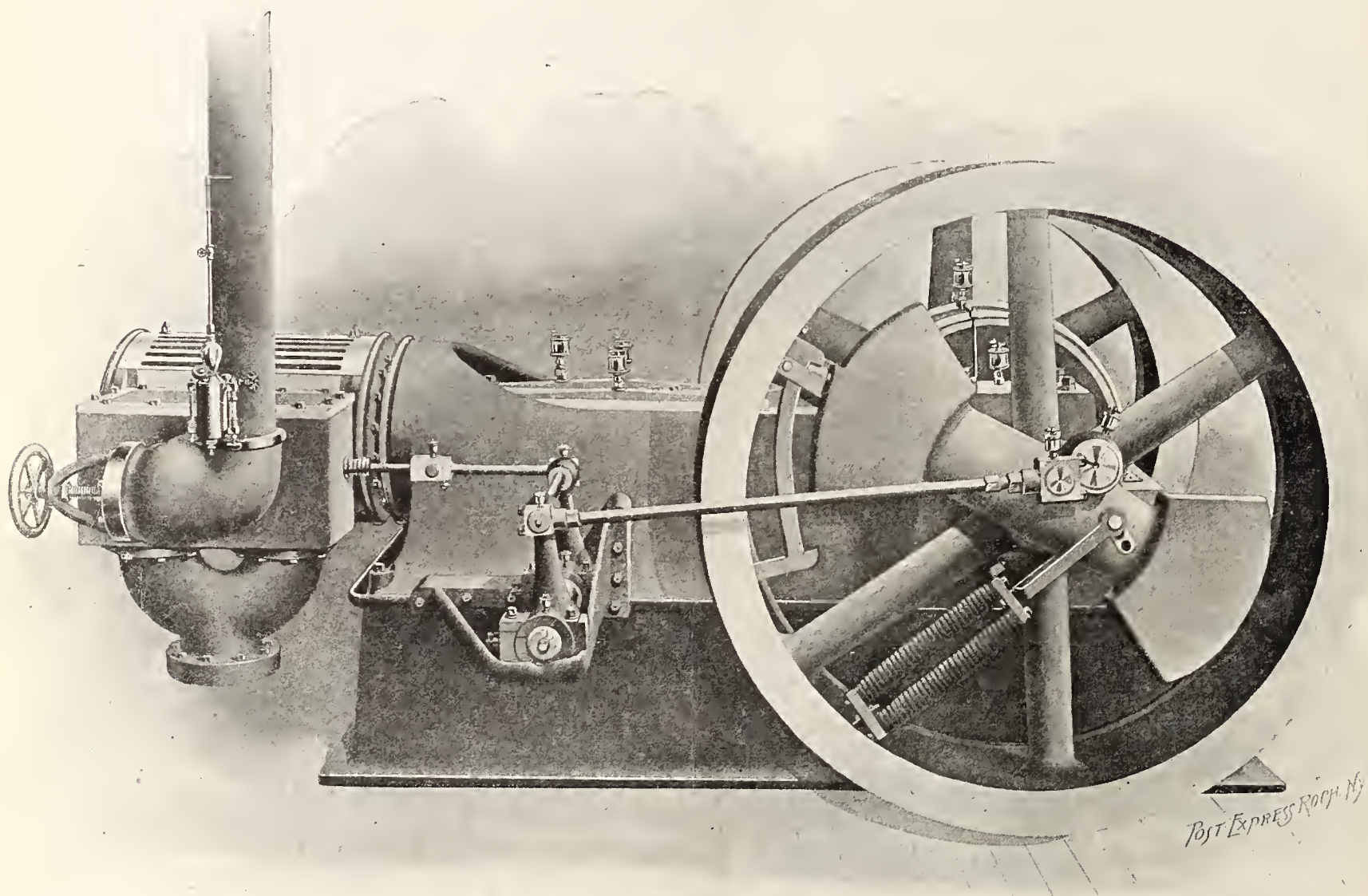
The field of electric mining, electric railways and the demands made upon an engine in factory and mill service have always been satisfactorily met by this high-class



Medium Speed, Side Crank, Tandem Compound Engine—Direct-Connected.

vision, calls for but a minimum of attention. In buildings each square foot of whose foundation is worth thousands of dollars, a direct-connected plant is the only one ever

engine. This problem which comes to the installee of an electric light or power plant is one that is often of the most puzzling character. To those of wider experience a doubt



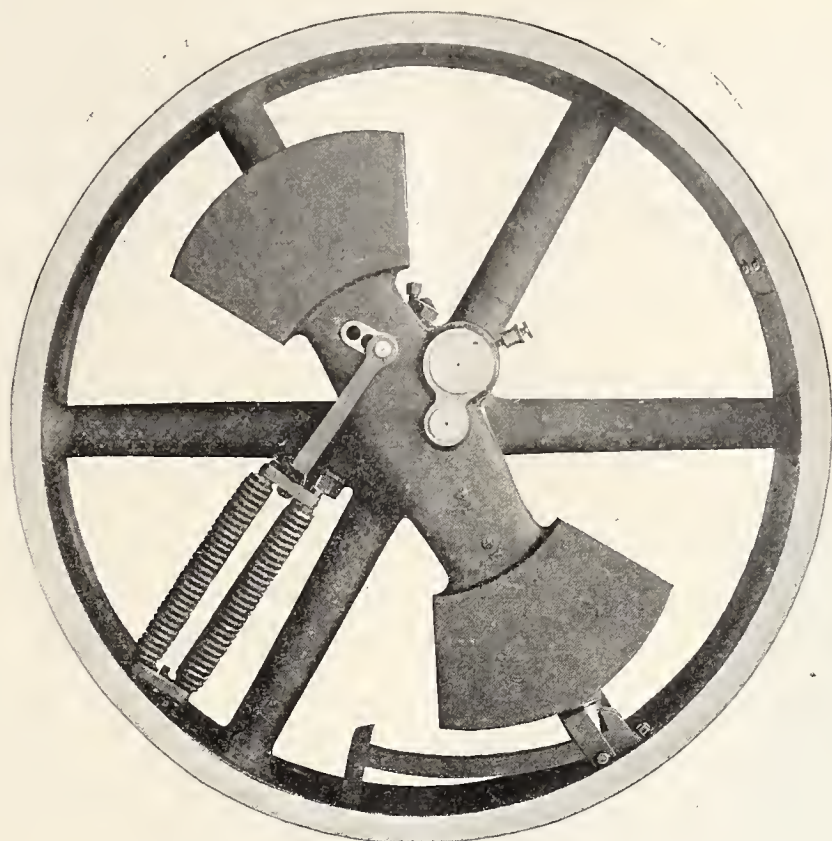
Single Cylinder, Centre Crank Railway Engine.

considered, and through the magnificent regulation, high efficiency and fine exterior of the Ball engine, such plants have become a pronounced success.

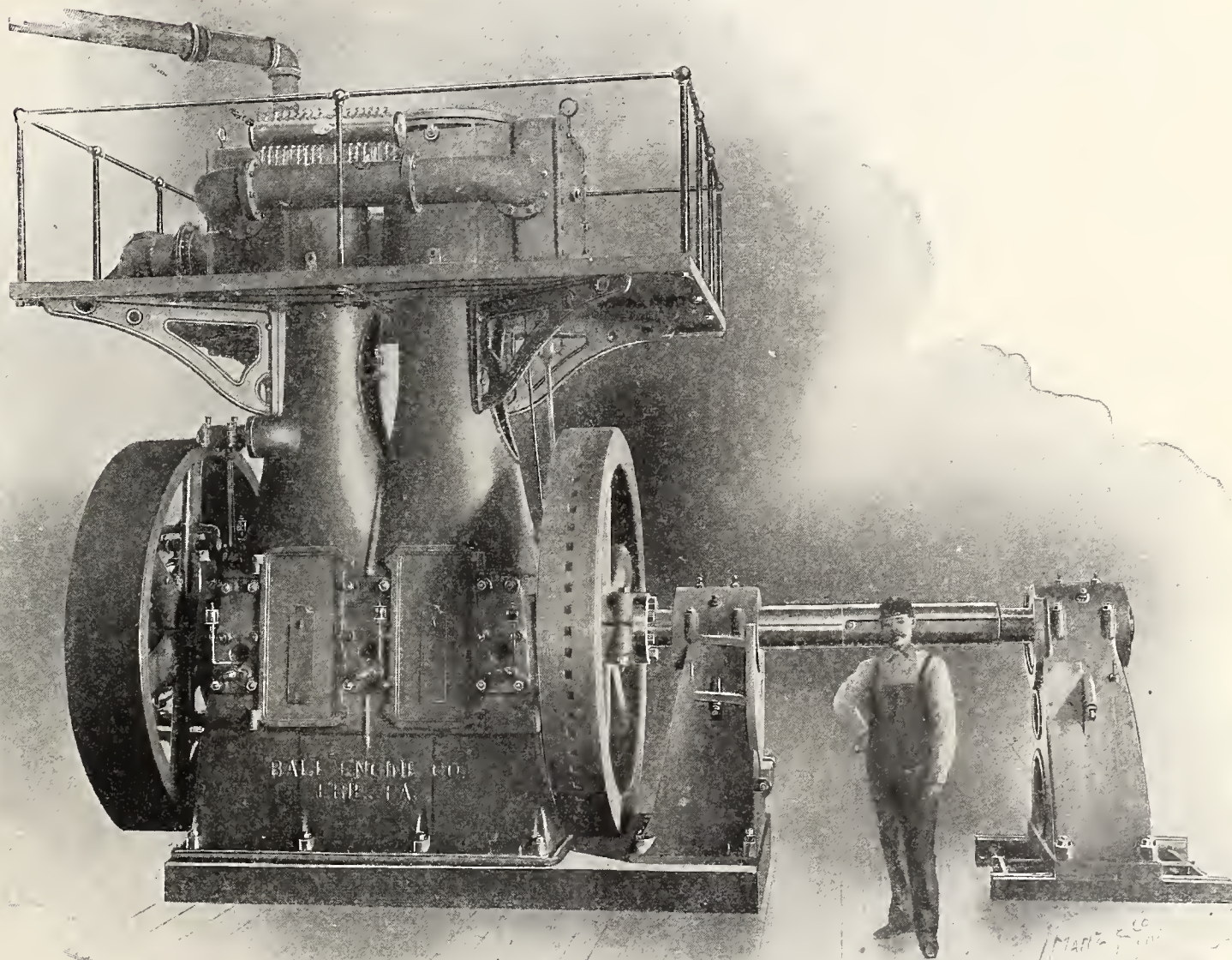
never enters their minds as to whether an engine of the finest quality should be procured or one of inferior construction. The choice of the better is a foregone conclu-

sion, not merely because a high-class engine bears the same relation to an electric light plant that a jewel-bedecked watch might to its happy possessor, but because,

inferior grade. The Ball engine pays a dividend each month to its owner, due to the excellent wear, high efficiency and permanent strength of each operating part.



The Governor.



Vertical Cross-Compound Engine—Arranged for Direct-Connection.

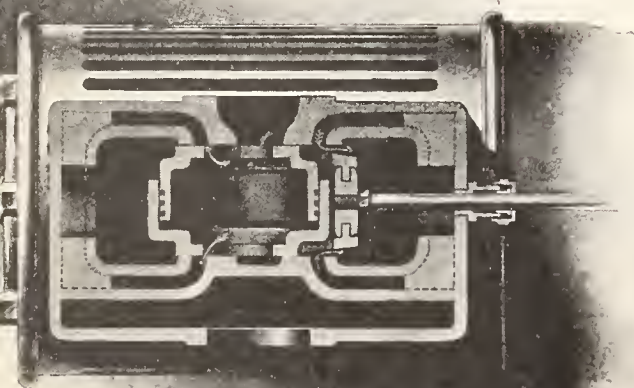
as a question of pure finance, there is more money made in the end by buying the best than saved by obtaining an

The severe strain of street railway work is admirably met by the single cylinder, centre crank railway engine. The

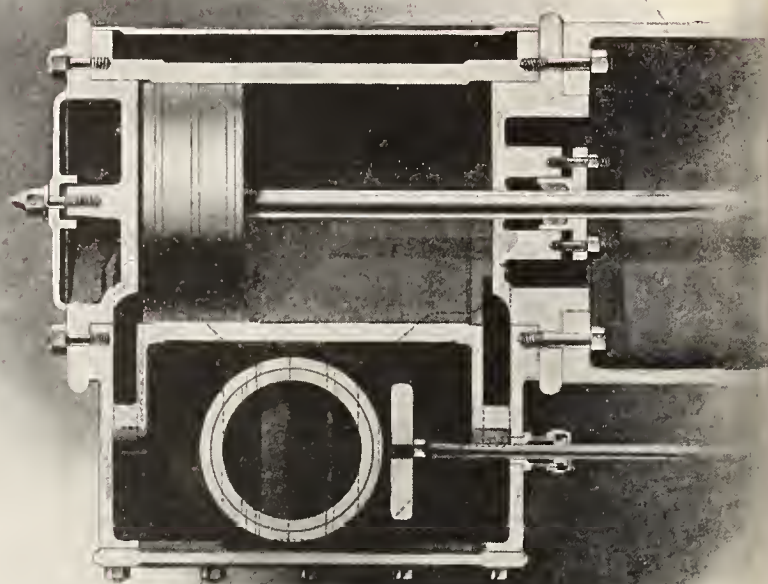
medium speed, side crank, tandem compound engine, direct-connected, is of immense value for electric lighting, whereas this latter type is particularly well adapted for changing loads.

It is certainly evident that an engine able to meet the severest test is of ideal construction for both electric lighting and street railway work. The governor, shown in sketch, the centrifugal element upon which the degree of refinement of all governors depends, is combined with an inertia element relatively so great that instant and ex-

forcing grease, by means of a compression grease cup, into a number of recesses arranged around the bore of the bushing. The Ball engines are of the single valve type. This valve is perfectly steam tight; this is due to a steam enforced contact alike at all points of the stroke. It is maintained by perfectly smooth surfaces, through which live steam cannot blow into the exhaust during admission or into the port during exhaust. Of the various styles of engines manufactured by the Ball Engine Company, the vertical cross compound arranged for direct connection is



The Valve.



The Cylinders.

treme changes of load are immediately provided for without waiting for the otherwise necessary manifestations of centrifugal force. It not only regulates to a very high degree of perfection, but with a very rapid adjustment and without the slightest instability, and therefore admirably fulfils the demand. The entire governor consists of a single moving piece suspended upon one pivoted point, thereby reducing the friction to a minimum. The suspension pin, which is of ample size, is made of hardened tool steel. The suspension is lined with frictionless metal, and the little lubrication that is required is accomplished by

the most striking in construction. Its operation is as smooth as possible, and the small floor space occupied gives it immense value in the eyes of electrical engineers. The single cylinder engine is automatically lubricated, in consequence of which it requires no attention and calls for no extra skill on the part of the engineer in charge. Both the vertical and horizontal engines of this company have proved their value on so many occasions in first-class establishments that it is hardly necessary to refer to the long list which the reader, on application, can obtain from the Ball Engine Company's office and works at Erie, Pa.

The Electrical Age.

ESTABLISHED 1883.

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THE METROPOLITAN TRACTION COMPANY.

For the benefit of such of our friends as are directly interested in street railways, the following extract from an editorial in the "Evening Sun" will show what tremendous power will be possessed by the above corporation on the granting of its franchise. Whether the Metropolitan Traction Company will make full use of its rights in the field of electric light and power remains to be seen. A collision between them and the other companies would be inevitable if such were the case, with the ultimate annihilation or absorption of the weaker. Let us hope that this will not occur. Street railways are very profitable in crowded cities, and the above corporation can quickly earn a larger and better stipend by sticking to traction alone. It will thereby earn the respect and esteem of thousands in Greater New York and of all the generous-minded electrical men the profession is blessed with.

"Within a twelvemonth the Metropolitan Traction Company will be in the full enjoyment of the greatest franchise ever conferred by the City of New York, not even excepting that of the elevated railroad system. It will be engaged in the profitable sale of the electrical current for power and illumination along our great and busy thoroughfare of Broadway, and along every important avenue in New York City, and around the corners of all the streets whithersoever it may choose to penetrate. It is difficult to form any adequate conception of the value of this franchise; it is impossible to overestimate its possibilities of profit and wealth. It is a monument to the genius of William Collins Whitney.

"As the cable takes the place of the horse, electricity supersedes the cable; but electricity does not merely supplant the cable; it reaches out from its subterranean trench to command in one all-embracing grasp what is probably the most profitable and extensive enterprise on Manhattan Island. Early in October the 'Evening Sun' set forth concisely and correctly the fact that this gigantic franchise was in process of acquisition. We showed what was its extent and purpose, and we asked: 'Has no man a word to say? In all this great city is this extraordinary spectacle the concern of not one single taxpayer?'

"It is today beyond recall. The Metropolitan Traction Company and the corporations allied with it are in possession of a franchise from the City of New York which confers a monopoly of the distribution of electricity for power and light.

"Such are the advantages which they have acquired that those corporations and individuals now supplying electrical power and light within the region of the city will no longer be able to do so as against the new competitor.

"It will be the greatest wholesale producer of electrical current in the world, and the factor of economy in electricity is not only moving steadily in the direction of greater and greater economy, but has even now reached the point at which the current is produced for power and light at a cost less than the most sanguine dreams of electricians have led them to hope for.

"Entrenched beyond the possibility of competition, with no fears of assault from any quarter whatsoever, the company which Mr. Whitney's genius has wrought to its present greatness is today the greatest mine of wealth, power and authority that ever in history took a vast municipality into its practical possession."

We have but this to say in conclusion: A monopolization of the lighting, power supply and street railway industry by the Metropolitan Traction Company would bring prices down to so low a figure that the general public, "the toiling masses," could enjoy the luxury and advantages the free use of electricity entails. Once let them use it for heating, lighting and cooking at a moderate cost, and the proportions the sale of electricity would swell to would be enormous.

THE CHAIR OF ELECTRICAL ENGINEERING AT THE MCGILL UNIVERSITY.

A Canadian exchange gives some biographical notes of Prof. R. B. Owens, who has been appointed successor to Prof. Carus-Wilson in the W. C. McDonald chair of electrical engineering at McGill University, Montreal. Prof. Owens, who is a comparatively young man, was selected from among the teaching staff of the great universities of the United States. He was at one time connected with the old Baxter Motor Company, but subsequently resumed study under Dr. Louis Duncan at Johns-Hopkins University, Baltimore, and obtained a high standing in mathematics and physics. In 1891 he studied under Prof. Crocker at the Columbia University and obtained the degree of E. E. Nebraska University is indebted to him for some excellent organization work. He was, in 1894, Professor of Electrical Engineering there, and in 1895 he took full charge of the Department of Electrical and Steam Engineering. He was one of the judges of electrical exhibits at the World's Fair. He was recently elected to a Tyndall Fellowship by Columbia University, is a member of a number of American engineering societies, and vice-president of the American Institute of Electrical Engineers.—London Elec. Rev.

Thibodeaux, La. — The Mayor may give information concerning establishment of electric-light plant.

STRAY CURRENTS.

ELECTRICITY IN THE STOCK YARDS.

Messrs. Armour & Co. have determined to utilize electricity largely in place of steam for operating equipment at their various plants. It is stated that the electric apparatus will include machines for supplying 5,000 lights, and other dynamos aggregating 4,800 horse power will be utilized.—Ex.

LONG-DISTANCE TRANSMISSION PLANT.

Ten thousand horse power will be transmitted 110 miles to San Francisco if the plans of a company, of which Prince Poniatowsky is said to be the head, are completed, says "Engineering News." It is proposed to utilize the water now running to waste on the western slope of the Sierra Nevada Mountains in Alpine, Amador and Calaveras Counties, constructing a system of canals and a power plant. The transmission line at one place will cross San Francisco Bay with a span about 325 feet above the water. The total cost of the plant is estimated at about \$1,000,000.—Ex.

ELECTRIC LIGHTING OF THE PYRAMIDS.

Lighting the pyramids of Egypt with electricity and the installation of a 25,000 horse power plant, to cost some \$400,000, is a plan now under consideration by the British government, and the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., are reported as likely to receive the contract. As outlined, the plan includes the generation of electric power at the Assouan Falls, on the Nile River, and its transmission a distance of 100 miles through the cotton growing districts, where, it is believed, the cheap power will permit the building of cotton factories. It is planned to use the power to illuminate the interior corridors of the pyramids and also operate pumping machinery for irrigating large areas of desert along the Nile.—Ex.

MAGNETIC STUDY OF IRON.

It has long been known by physicists that iron alters in length when magnetized. This phenomenon is made the subject of a special study by Professor Brackett, of Princeton, in "The Physical Review," December. The author treats specially of the effects of tension and of the quality of the metal upon such changes in length in iron wires, and he describes researches made by him at the suggestion of Prof. Rowland, of Johns-Hopkins University. Prof. Brackett believes that the investigation has established the following laws: "Any increase in the magnetic induction tends to lengthen the iron wire; the magnetizing field tends to shorten the wire, and the shortening due to this cause apparently has no limit; the elasticity changes with the induction; . . . but the law of the change is unknown, further than that elasticity changes only as the induction changes."—Ex.

THE CENTENARY OF GAS LIGHTING.

Electricity has now so largely supplanted the older methods of illumination that people have almost forgotten that this year is the centenary of gas lighting—coal gas having been first applied to economic uses by William Murdoch in 1798, although it was not introduced into London until 1807. In 1825, when meter reckoning came into general use, the rate charged was fifteen shillings per 1,000 cubic feet, subject to a discount of five per cent. for prompt payment. At a later date twelve shillings was charged, and in 1834, three years before Queen Victoria ascended the throne, a further reduction was made, the price becoming ten shillings per 1,000 cubic feet. It is now as low as two shillings and six pence (sixty-two and a half cents) per 1,000 cubic feet in some parts of the United Kingdom.—Ex.

POPULARITY OF AMERICANS IN CHINA.

Speaking of the arrival of our new United States Minister at Tientsin, our consul there mentions the general popularity of Americans in China. Expressions of friendship for our people, he says, are heard in official and business circles. He notes a contract just made by a representative of the government with a Philadelphian for the purchase of all machinery necessary to establish an up-to-date woolen mill at Tientsin. The electric machinery will come from the Westinghouse Electric Co.; the boiler and engine from the Harrisburg Foundry and Machine Co., and the remaining machinery from the James Smith Woolen Machine Co., of Philadelphia.—Ex.

PERSONAL.

Lord Kelvin has accepted a seat on the board of the Linotype Company, Limited, in succession to the late Dr. John Hopkinson, F. R. S.—Ex.

WATER POWER IN SWITZERLAND IN 1897.

"L'Electricien" has recently published some figures upon this subject, and below we give a summary of the more important ones appearing in that paper. During 1897, 35 new projects received the sanction of the authorities, and five extensions of existing installations were also approved. Of the 35 new schemes, 17 were lighting schemes, 4 were transmission schemes, and 14 were combined lighting and transmission schemes. Continuous current was to be used for 14 lighting installations, 1 transmission scheme, and 7 of the combined lighting and transmission plants. The tri-phase system was to be used in connection with the remaining 13 schemes. Most of the schemes were small, and support the statement that shortly every little village in Switzerland will be lighted and supplied with power for its smaller industries by electricity developed from water power in the vicinity. The total power of the 35 new schemes is made up as follows:

	Kilowatts
27 installations under 100 kw.....	925
6 " 100—500 kw.....	1,324
2 " over 500 kw.....	2,740
Total.....	4,989

This total is 1,758 kw. less than that of the preceding year. The decrease is explained by the fact that all the larger and more easily developed waterfalls have already been exploited.—London Elec. Rev.

WIRELESS TELEGRAPHY.

LIGHT ELECTRIC TELEGRAPHY.

Professor Zickler, of Brunn, has conducted an elaborate series of experiments which show that a telegraphic instrument can be actuated at considerable distances by a beam of ultra-violet light. He employs a powerful arc lamp as his transmitter, using a screen of glass to produce intermittent flashes of the ultra-violet beam, which embody themselves as dot and dash signals on his receiver. The receiver is an air-gap in a circuit containing an induction coil regulated to an electromotive force just below the sparking point at the air-gap. As Hertz long ago has shown, a beam of ultra-violet light falling on the cathode of a strained air-gap near its breaking-down point, will immediately provoke a discharge.—Ex.

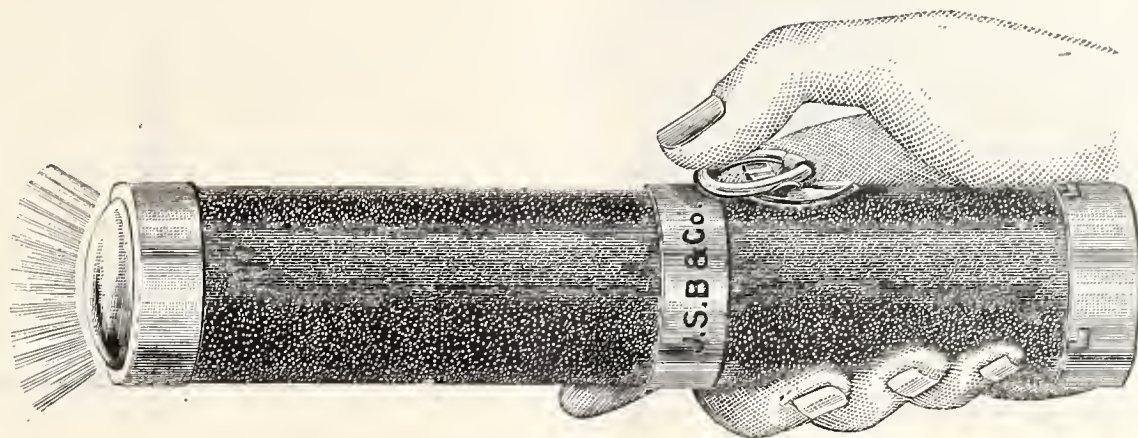
Charlotte, N. C.—The Queen City Telephone Co. has been organized with J. A. Helvin, president; A. G. Brenizer, treasurer.

ELECTRICAL NOVELTIES.

A NOVEL ELECTRIC POCKET LAMP.

The risk of life and danger from fires due to the striking of matches is very great in large cities. In many establishments where combustible material and explosive chemicals are manufactured and handled, exposed flame, such

shows the Ryder desk lamp applied to the inside of a roll-top desk, it being the only light made with an attachment to fit any roll-top desk, which can be folded down when not in use and allow the desk to be closed, thus keeping out dust and dirt which naturally accumulates on exposed desk lamps. The Ryder specialties have an adjustable arm, allowing the light to be thrown in any direction desired. The Ryder lamps are all corrugated



Pocket Electric Light.

as gas, candle, oil lamp or match will produce, is strictly tabooed. An absolute demand has arisen for a safe illuminant, a source of light which incurs no risk by its use. The new pocket electric light manufactured by James S. Barron & Company, manufacturers of, and wholesale dealers in, general electrical supplies, 24-30 Hudson street, New York City, possesses all the features required to make it safe and reliable. It is the most serviceable electric light on the market and is self contained. There are no wires to get out of order and no chemicals to spill. It can be placed in the midst of gas or gunpowder; in fact, where no other light can be used, with perfect safety. There are no odors, and it is always ready. If placed under the pillow at night, it may be immediately used for seeing the time.

As regards its portability, the illustration shows it one-half its real size. Its weight is insignificant and the light it throws out comparable to a miniature search. Three cells of battery within the case supply power to the lamp. It will light as long and as often as six thousand matches and costs considerably less. When the batteries deteriorate, which takes a very long while, they are renewable at slight expense. The pocket electric light will, with use, become an indispensable article to people in all walks of life.

RYDER'S ELECTRICAL SPECIALTIES.

In an article published in the New York "World" of July 3, 1898, entitled "Does Electric Light Affect the Brain?" the injurious consequences of having the glare of an electric light strike the brow of a person uninterruptedly, as shown in Figure 8, are described and the evidence of a large number of eminent physicians and surgeons fully bears out this statement. In a large number of cases it was found that loss of sight, dullness of vision, brain fever, etc., were caused by electric light falling directly upon the forehead, as shown in the illustration. In order to overcome this evil there has been a great number of devices invented for the purpose of diffusing the light and reflecting it directly upon the work of the artist, editor, author, book-keeper, merchant, banker, etc., and thus keeping it away from the eyes and head.

Messrs. A. H. Ryder & Company, electrical engineers, of 180 Broadway, New York City, have been experimenting for a number of years upon devices for diffusing and softening the rays of electric light for use in offices, etc., on roll and flat-top desks, etc.

The following illustrations give an idea of the success of the Ryder specialties in desk and table lamps. Figure 1

and white enamelled on the inside, enabling them to cast a most brilliant reflection. The eye-shade is easily adjustable to suit.

All cylinders of the lamp proper contain an ingenious device for holding the lamp socket in place and for adjusting it to any make of socket. They make in this general design a number of lamps, as shown in Figures 4 and 5, for roll top and bookkeepers' desks and in portables, as shown in Figures 2 and 3. Special attention is called to Figure 2, showing a double portable, which can be taken apart and placed in one of the Ryder handsome cardboard boxes for shipment to all parts of the world.



Fig. 8.

All of their lamps are kept in these boxes for shipping and shelving in supply houses, etc., thus permitting no dust or fly specks to reach them, keeping them bright and clean at all times.

All these various styles of desk and portable lamps are interchangeable or adjustable to all the attachments of the Ryder lamp. Figure 6 shows the lamp fixed to a side wall; it can be swung in either direction, and is made to meet requirements where desk lamps can not be used. Figure 3 shows a single portable for flat top desks, etc. Like the double portable, it can be raised or lowered or swung in any position desired.

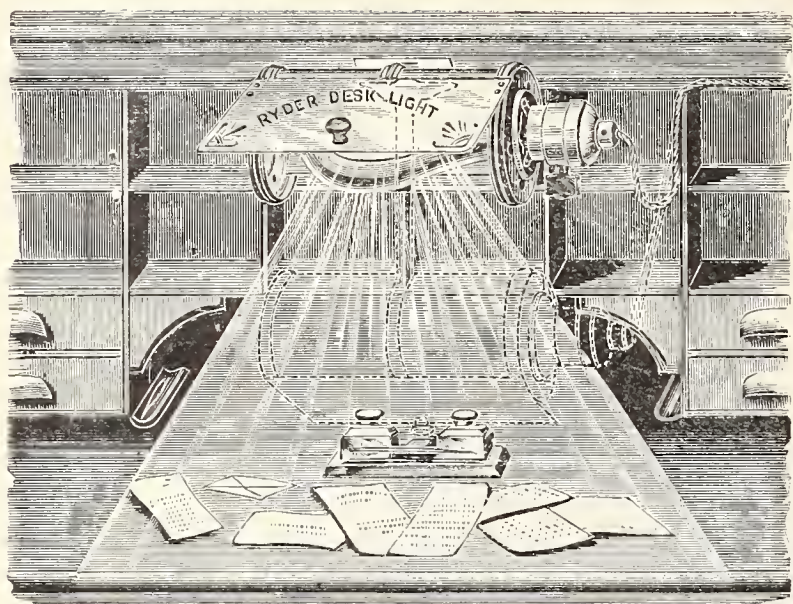


Fig. 1. The Ryder Desk Light shown Inside Roll Top Desk.

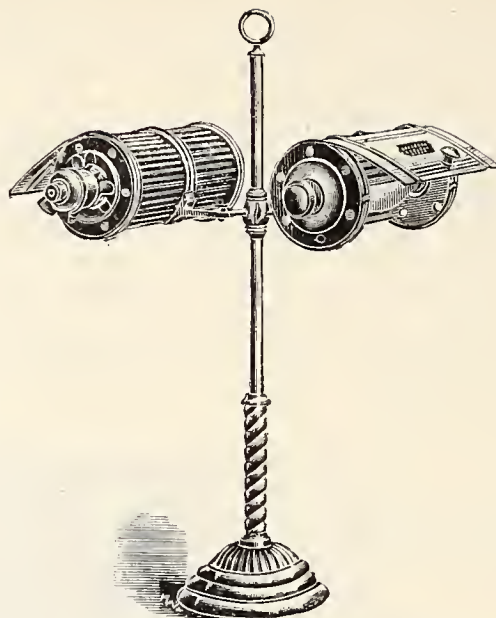


Fig. 2. Double Portable Flat Top Desk or Table Lamp.

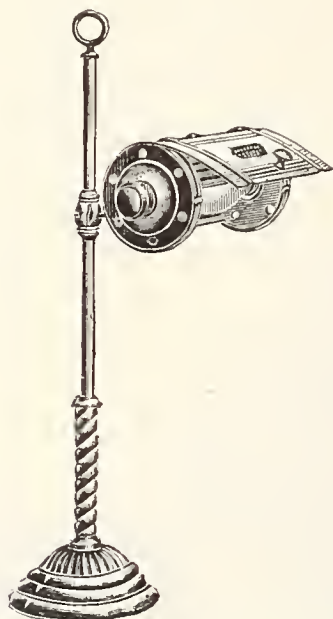


Fig. 3. Single Portable for Flat Top Desks, etc.

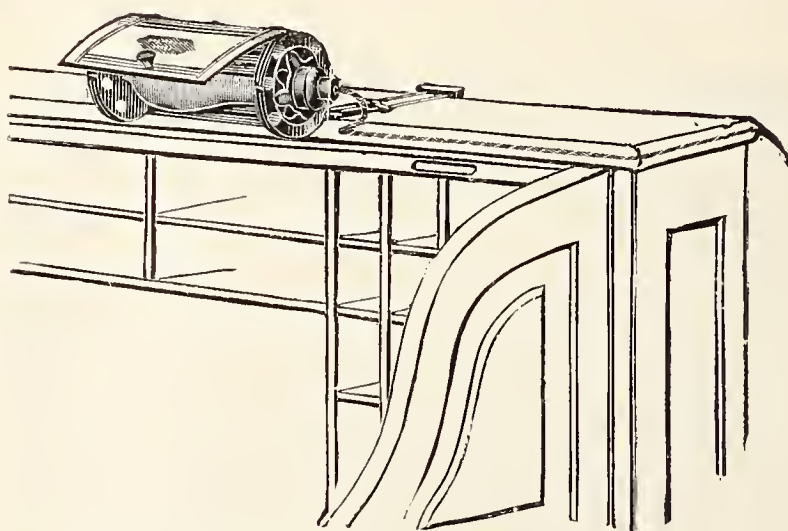


Fig. 4. Top Attachment on Roll Top Desk.
Made to fit all styles of roll top desks, add interchangeable with all other styles of Ryder's attachments.

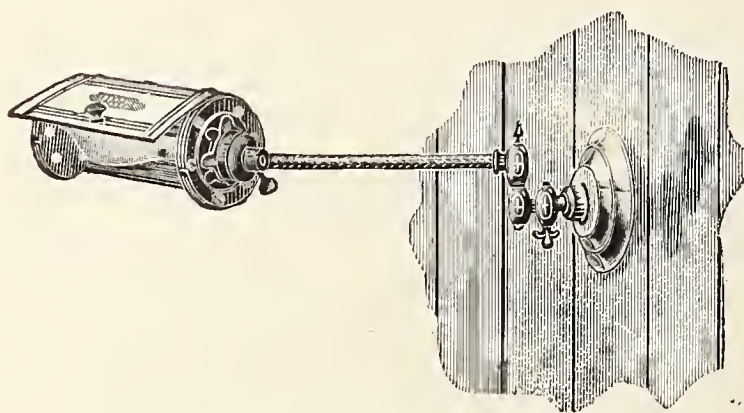


Fig. 6. Swinging Bracket Lamp.

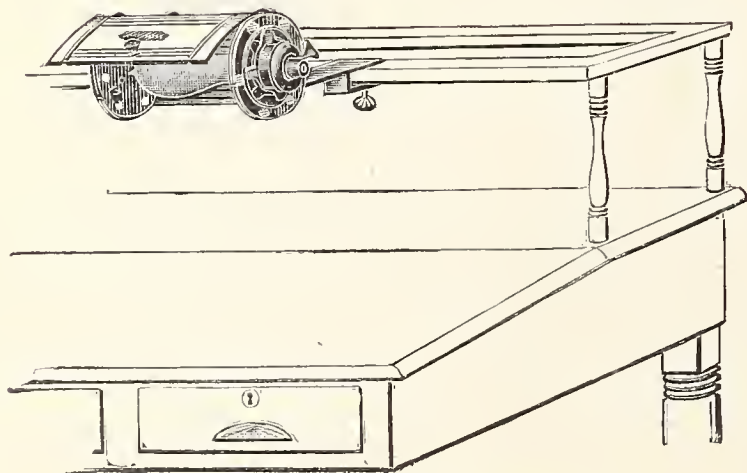


Fig. 5. Bookkeepers' Upright.

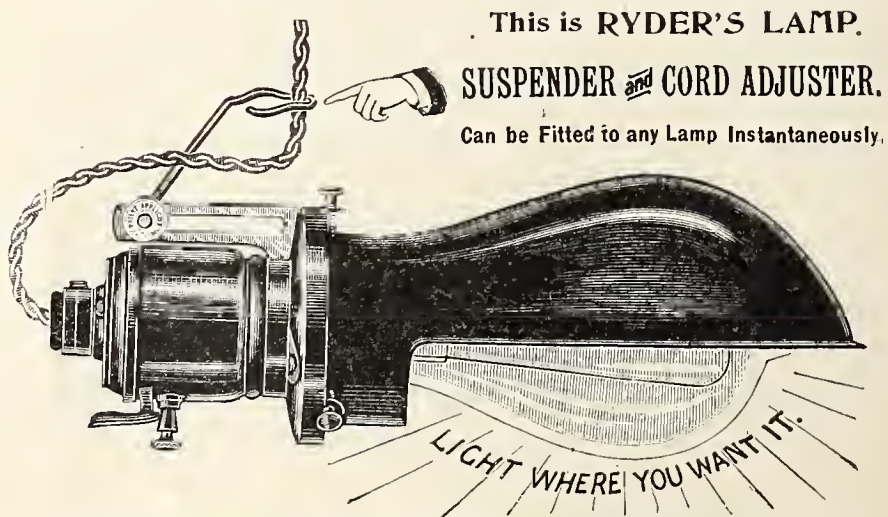


Fig. 7. Cord Adjuster Attached to Lamp with Aluminum Half Shade. Can be set to any height and adjustable to any position.

Particular attention is called to Ryder's special lamp, which can be used with any of their desk or portable lamps, and is the only desk lamp which you can regulate and soften the light, if desired. Figures 7, 8 and 12 illustrate Ryder's lamp suspender and cord adjuster attached to an incandescent lamp with aluminum half shade. The adjuster can be fitted to any style of incandescent lamp and socket, and permits the

CONDUCTORS.

SUCCESS OF ATTIX WIRE.

Attix electric light wire had a long fight for recognition and it was only through persistently keeping up his demands that the inventor, Mr. Thomas F. Attix, a prominent electrical engineer of 283 Flatbush avenue, Brook-



Fig. 12. Lamp Suspended on Cord Adjuster.

lamp to be raised or lowered and takes the strain off the connecting screws inside the lamp socket. A slight turn of the thumb nut, shown in this attachment, unlocks the universal joint and allows you to place the lamp at any angle desired instantly. Figure 11 illustrates the difficulty and obstacles met with in the old

lyn, was finally successful. In January, when the Building, Lighting and Supply Department of Greater New York took charge of the inspection of wiring, they passed upon Attix wire and allowed its installation in all buildings where circular loom tubing can be used. This wire is water and fire-proof in the highest degree, being first cov-



Fig. 10. The New Way.



Fig. 11. The Old Way.



Fig. 12. What Brownie Saw.

style cord adjuster. Figure 12 illustrates the convenience of the adjuster in allowing the lamp to be placed at any angle desired. Figure 10; this man has no time to spare; he can adjust the lamp without getting up out of his chair.

A. H. Ryder & Company will send full and explicit directions with illustrations showing how to put up any of their specialties. Prices and discounts will be sent on application. They will call and install any of their specialties in this vicinity, as they are expert wiring contractors,

ered with the best grade of Habirshaw, standard red core insulation, then braided, and after this covered with a water-proof tube. Covering the whole is a fire-proof tube, made of a secret composition, and guaranteed to be flame proof.

Attix wire, with its fire and water-proof covering, costs less than rubber wire run in flexible tubes or iron conduit, and is a much better safeguard, there being no air space left between the rubber and tube. Attix wire installed over six years ago is just as serviceable today as when first

put in service. Not one foot of Attix wire has had to be removed since its installation, a proof of the good qualities of the same. No taps are allowed on this wire, all wires being run on the loop system.

Six years ago Prof. Morton made the severest kind of tests ever made before or since on any kind of insulation, and found that Attix wire came fully up to the standard. One of the tests was allowing it to remain in wet mortar for a long period, through which ordeal the wire passed successfully.

EXPOSITIONS.

1899 ELECTRICAL SHOW.

At the annual meeting of stockholders of the Electrical Exhibition Co., held Monday evening, November 21st, 1898, it was unanimously decided to hold another electrical exhibition in New York City in 1899.

The following officers and directors were elected:

C. O. Baker, Jr., president; F. W. Roebbling, vice-president; Geo. F. Porter, secretary and treasurer; H. H. Harrison, L. F. Requa, J. W. Godfrey, C. A. Lieb; Marcus Nathan, general manager.

CANADIAN ELECTRICAL NEWS.

ELECTRIC LIGHTING IN CANADA.

St. Thomas, Ont.—It is understood to be the intention of Mr. J. H. Still to rebuild his handle factory. It is probable that the pipe foundry will be rebuilt. The People's and the Bell Telephone Companies will be asked to submit new propositions for a telephone franchise.

Levis, Que.—At the next council meeting the question of introducing waterworks and electric light systems will be discussed. The project, if carried out, will cost from \$200,000 to \$300,000.

London, Ont.—The People's Telephone Company, according to report, intend to install a plant here at once. They will purchase their supplies from the Stromberg-Carlson Manufacturing Co., of Chicago, who will likely start a factory here.

Hamilton, Ont.—Mr. Percy Domville has been instructed to prepare an estimate of the cost of an electric lighting plant of 300 arc and 3,000 incandescent light capacity by the Electric Light Committee.

Toronto, Ont.—The Toronto Electric Light Co. and the Metropolitan Railway Co. have submitted tenders for the electric lighting of the village of Deer Park.

Hull, Que.—Tenders for lighting the city by electricity will shortly be invited.

Seaforth, Ont.—It is understood that a company is being formed to operate a telephone exchange here.

Victoria, B. C.—The Electric Light Committee have recommended that city invite tenders for twelve arc lamps and half a mile of electric wire.

North Sydney, C. B.—Mr. J. A. Young, of the Sydney Gas and Electric Co., has floated the Glace Bay Electric Light and Power Co. for the purpose of supplying electric light to the village of Glace Bay. The power house will be located at the abandoned Stirling pit.

Ingersoll, Ont.—The town council have appointed a committee to negotiate for the purchase of the waterworks and electric light plant and to arrange for the construction of a main sewer on Thames street.

Beeton, Ont.—The contract for an electric light plant for the town having been given out, steps will be taken

at once to build a power house and to purchase an engine and boiler.

Ottawa, Ont.—The Deschenes Electric Co. will, it is said, make another application to the city for a franchise for electric lighting and power.

J. ALCIDE CHAUSSE.

ELECTRIC RAILWAYS IN CANADA.

Hull, Que.—The question of extending the Hull & Aylmer Electric Railway to Gatineau Point is under consideration of the directors. It is the intention to commence the construction next spring. At the last meeting of the city council it was decided to call at once for tenders for lighting the city by electricity.

Three Rivers, Que.—In connection with the water power of the Shawenegan Falls, on the St. Maurice River, the contract for hydraulic work was let to Messrs. Barry, Ross & McRae, of Niagara Falls, Ont. It is probable that the scheme will include the construction of an electric railway from Shawenegan Falls to Three Rivers, a distance of 19 miles.

Quebec, Que.—An official announcement has been made by the Quebec, Montmorency & Charlevoix Railway Company that it is proposed to electrify the road that runs to Cap Tourmente and construct an independent line to Montmorency Falls. The estimated cost is given at \$330,000, and when completed will comprise over 60 miles of electric railway. Mr. H. J. Beemer is president of the company.

Sarnia, Ont.—A meeting of the Railway Committee of the town council with the representatives of the Lambton Central Railway and the Sarnia Street Railway relative to the proposed suburban line.

Bridgetown, Ont.—A meeting of gentlemen interested in securing an electric railway between Thamesville, Bridgetown and Rondeau Park was held here last week, at which it was decided to apply for a charter as soon as the necessary funds could be procured. Among those present were Mr. R. Ferguson, M. P. P., and Mr. W. E. Gundy.

Victoria, B. C.—In behalf of a Victoria syndicate, Messrs. W. Jenson and S. Goodacre give notice of application for the incorporation of the Hardy Bay Tramway Co. to build a tramway from Hardy Bay to Cold Bay, Quatsino Sound, a distance of eight miles. It is probable that electricity will be the motive power.

Toronto, Ont.—The Toronto Street Railway Company is considering a scheme for radial electric railways throughout the province, with Toronto as headquarters. The company have not yet, we learn, reached any decision in the matter.

Cornwall, Ont.—It is understood that some improvements will be made to the system of the Cornwall Electric Railway Co., of which D. A. Starr is manager.

Hamilton, Ont.—The promoters of the Hamilton, Chedoke & Ancaster Electric Railway have made a new proposition to the city council, which has been accepted. It is hoped that now it will be possible to finance the project.

Hamilton, Ont.—The Hamilton Radial Railway Co. has decided to extend its line from Burlington to Port Nelson. Operations on the construction will be commenced immediately, it is said.

St. Thomas, Ont.—It is probable that the St. Thomas Street Railway will be extended to Port Stanley. J. H. Still is president.

J. ALCIDE CHAUSSE.

OBITUARY.

LATIMER CLARK.

Latimer Clark, C. E., F. R. S., the inventor of the standard cell, died October 30th, at Twickenham, England. Mr. Clark was born in 1822, and is best known through his paper, read in conjunction with Sir Charles Bright, presenting a definite system of electrical measurement in ohms, volts and farads, this practically forming the basis of modern electrical scientific measurement. Mr. Clark was actively connected with many submarine telegraphic enterprises, and also introduced a number of improvements in telegraphy.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL ELECTRICAL EXPORTS FOR WEEK END- ING NOV. 22, 1898, \$100,971.00.

New York, N. Y. Nov. 22, 1898. The following exports of electrical material are from the port of New York for the week ending this date:

- Antwerp—20 cases electrical material, \$2,097.
- British East Indies—14 packages electrical material, \$400.
- British Australia—28 cases electrical material, \$1,355.
- Berlin—4 packages electrical machinery, \$872; 2 cases electrical material, \$50.
- Brazil—179 cases electrical material, \$5,258.
- Bremen—5 cases electrical material, \$375.
- Brussels—3 cases electrical material, \$65.
- British West Indies—71 cases electrical material, \$3,004.
- Cuba—18 cases electrical material \$703.
- Central America—1,632 packages electrical material, \$3,934.
- Frankfort—1 case electros, \$10.
- Hamburg—11 packages electrical material, \$2,262; 56 packages electrical material, \$2,867.
- Hayti—3 cases electrical material, \$33.
- Havre—106 cases electrical material, \$17,877; 68 cases electrical material, \$3,852.
- Liverpool—18 packages electrical material, \$1 253; 70 packages electrical machinery, \$3,389.
- London—115 packages electrical material, \$3 510; 150 cases electrical machinery, \$38,293.
- Leeds—6 cases electrical material, \$221.
- Mexico—2 cases electrical machinery, \$167.
- Marseilles—14 packages electrical material, \$1,500.
- Munich—2 cases electrical material, \$29.
- Nova Scotia—2 cases electrical material, \$22.
- Naples—82 cases electrical machinery, \$3,050.
- New Zealand—24 cases electrical material, \$592.
- Newfoundland—3 packages electrical material, \$38.
- Newcastle—29 packages electrical machinery, \$3,000.
- Venezuela—1 package electrical material, \$53.

STREET RAILWAY NEWS.

Louisville, Ky.—It is proposed to build an electric railway from Louisville to Power Valley, a very large suburb of this city.

Lansing, Mich.—The Long Lake, Durand & Corunna Railroad Co. has been organized to build a line through

Shiawassee and Genesee Counties. Capital stock, \$50,000. The line will be operated by electric power, with Owosso as the central station.

New York, N. Y.—The Fort George Extension Railway Co. has been incorporated to operate an electric line on Eleventh avenue, from One Hundred and Seventy-second street to One Hundred and Eighty-fifth street. Capital stock, \$10,000.

Gadsden, Ala.—The Alabama Light & Power Co. will build a power plant, to cost \$25,000, to furnish electric-railway power, etc.

TELEPHONE CALLS.

Blissfield, Mich.—The Blissfield Telephone Co. has been incorporated with a capital stock of \$3,000.

Toledo, Ohio.—The Montpelier Telephone Co. has been organized with J. S. Bradley, manager. A local exchange will be operated in a month.

Cleveland, Ohio.—Interstate Telephone Co. has been incorporated with a capital stock of \$25,000.

Bryan, Mass.—Williams County Toll Line Co. has been incorporated to operate telephone line. Capital stock, \$30,000.

New Bedford, Mass.—The Automatic Telephone Co. has been organized with a capital stock of \$100,000. The company will immediately commence the construction of a first-class underground system, with private metallic circuits for each subscriber.

Grand Rapids, Mich.—Fuller & Perkins are organizing a stock company to establish a complete telephone exchange to cover Mason, Oceana and Manistee Counties.

Paducah, Ky.—Henry Biederman, who recently obtained telephone franchise, is organizing a company to install system.

NEW INCORPORATIONS.

New York, N. Y.—Newton Appliance Co. has been incorporated by Jas. A. Stiles, David E. Drake, Louis Heck, Chas. L. Eidlitz and B. F. Hamilton; to manufacture electrical specialties. Capital stock, \$25,000.

Grand Rapids, Mich.—The Newaygo Transmission Co. has been organized by local capitalists, with \$15,000 capital, to develop the water power at Newaygo and to transmit electric power to this city.

Newark, N. J.—The Electric Motor and Equipment Co. has been incorporated by Augustus J. Miller, Jos. G. Ward, Jr., and Frederick G. Agens, Jr.; to deal in, operate, manufacture, repair, etc., electric motors and electric machinery. Capital stock, \$100,000.

Caro, Mich.—Caro Light & Power Co. has been incorporated, with a capital stock of \$25,000.

Chicago, Ill.—National Electric Trades Association has been incorporated.

Chicago, Ill.—Gregory Electric Co. has been incorporated by C. A. Gregory, G. A. Fargher, G. K. Wadsworth. Capital stock, \$100,000.

Pierre, S. D.—The Chemical Battery, Light, Heat and Power Co. has been incorporated by Frank W. Lowery, E. L. O. Apel and E. L. Squire. Capital stock, \$5,000,000.

Waco, Tex.—The Mutual Electric Co. has been incorporated by W. S. Seley, S. W. Slayden, I. A. Goldstein and Tony Migel; to supply light and power. Capital stock, \$10,000.

NEW YORK ITEMS.

Francis Granger, the agent for the Corning Brake Shoe Company, now at 35 Nassau street, will remove to No. 26 Cortlandt street on December 1st. Mr. Granger is also agent for the Orient Electrical Company, Youngstown, O., manufacturers of all styles of incandescent lamps for railway and commercial purposes. Mr. Granger found it necessary to move to larger quarters owing to the growth of his business, and will be pleased to welcome his friends at his new address.

The Cherry Electric Works, 25-27 Third avenue, manufacturers of the Cherry ampere and voltmeters, are in receipt of many flattering testimonials from users of their instruments, among them being letters from the Hanson & Van Winkle Company, Newark, N. J.; the Electric Self-Playing Piano Co., city; the Manhattan Electrical Supply Co.; M. R. Rodrigues, Brooklyn, and others. These instruments have met with great favor ever since their introduction, owing to the care and attention bestowed upon their manufacture, thus assuring accuracy and reliability.

Mr. Ernest A. Lowe, manager of J. Jones & Son, the well known electrical supply dealers, of 64 Cortlandt street, has returned to his duties after a severe and prolonged attack of rheumatism. Mr. Lowe has been greatly missed by his many friends in the trade and the many customers of the firm. We congratulate Mr. Lowe upon his return to his labors and hope that he will be speedily restored to his old-time strength and vigor.

The Varyan Company, Times Building, are the eastern agents for the Frontier gas engines, especially adapted for electric light plants. These gas engines are made with two cylinders, tandem type, giving an impulse with every revolution. The Varyan Company also handle the Varyan multiple effect evaporators, grinding mills, special machinery, etc.

Goldmark & Wallace, 121 Worth street, are receiving orders for their well known Koch woven wire tube dynamo brushes from every State in the Union, the users of the same speaking in the highest terms of the good qualities of the brush.

Chester Cullingworth, eastern sales agent for the E. S. Stiles Press Co., 243 Centre street, is a young and energetic salesman. Mr. Cullingworth carries a large stock of presses and takes orders for presses for all classes of work. He has had an extended experience in the various departments of machinery manufacturing establishments, having graduated from the draughting department of one of the largest manufacturers in the country.

The Leclanche Battery Company, 111-117 East 131st street, the original manufacturers of Leclanche batteries in this country, have prepared a valuable little brochure of their batteries. This brochure contains valuable information for the electrical engineer and will be mailed, postage prepaid, on request to the above company.

Readers of the "Electrical Age" will find it to be to their benefit to write Charles J. Bogue, 215 Centre street, for descriptive circulars of his new American enclosed arc lamp, which is the superior in many qualities of any arc lamp now on the market.

Mr. Wildey, of 23 Duane street, is bringing out some useful holiday novelties, among them being a small kinetoscope run by a small motor, to be sold at a low figure. Write to the above address for further details.

The St. James Electric Company, 1133 Broadway, have brought out a very interesting novelty. It is a big seller, selling on sight, and we would advise our readers to write for circulars of the same.

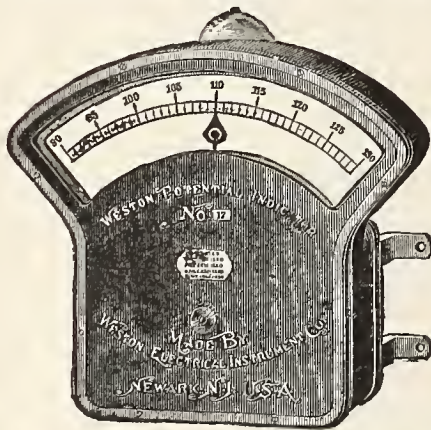
Stein & Langlos, manufacturers of electrical goods for the trade, 220 Centre street, have doubled their floor space, preparatory to meeting the demands of the trade. Write for circulars of their special inventions.

Baker & Fox, 83 Schermerhorn street, Brooklyn, have brought out an ingenious form of focussing lamp, made for either hand or automatic feed. They will send description of the same, together with circulars of the Fox photo-engraving lamps, theatrical effects, etc., on request.

H. B. Coho & Company, agents for the Eddy Electric Company, manufacturers of dynamos and motors, have opened up new offices at 143 Liberty street.

W. C. VOSBURGH MANUFACTURING CO., Limited, 269-281 State street, Brooklyn, the well-known gas and electric-light fixture manufacturing concern, have just issued a new No. 20 electric catalogue which will be sent free to responsible dealers upon request. Dealers having received a copy of the catalogue speak of it in the highest terms and say that it is the most complete book of its kind issued so far.

WESTON STANDARD ILLUMINATED DIAL STATION INSTRUMENTS.



THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

"VULCAN" AND



"INDEPENDENT"



STYLO AND FOUNTAIN PENS.

SEE OUR ADV. NEXT WEEK.

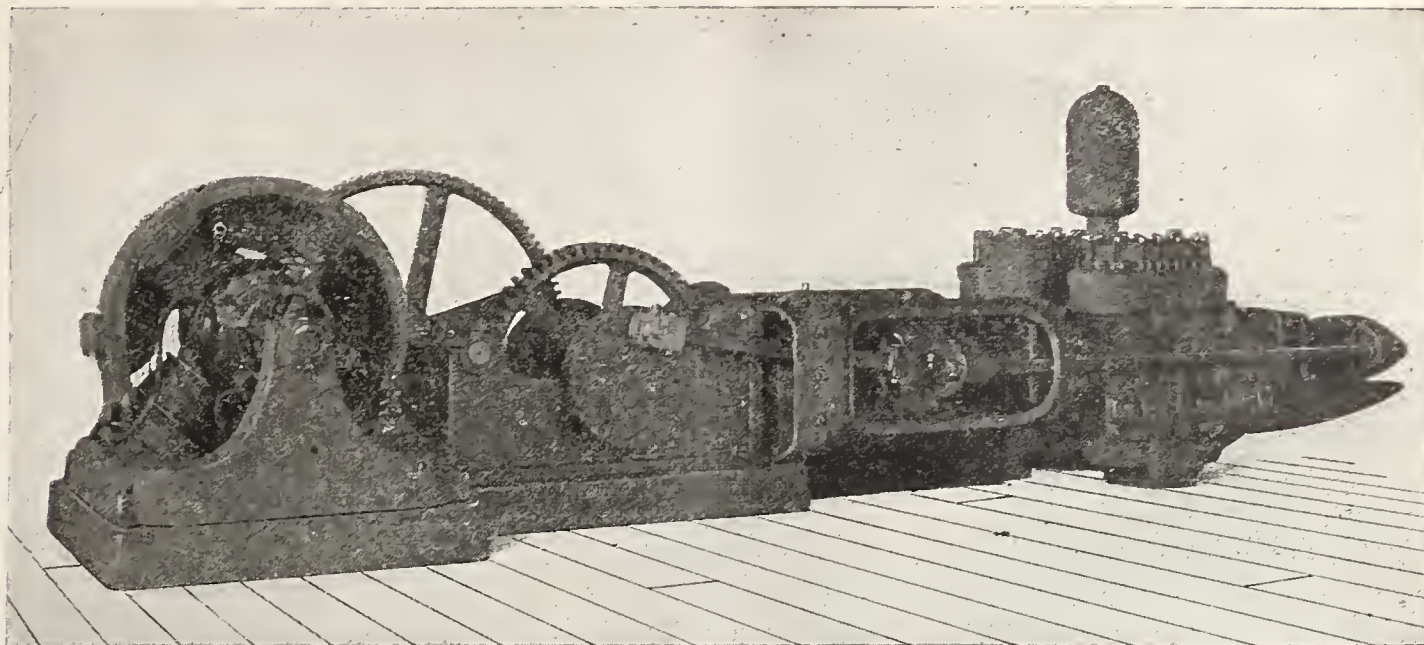
The Electrical Age.

VOL. XXII—No. 23

NEW YORK, DECEMBER 3, 1898

WHOLE No. 603

ELECTRIC MINING.



Double-Action Pump for Falls from 150 ft. Head. 50 H. P. Motor. D., L. & W. R. R., Bellevue, Pa.



Mt. Lookout Mine, Wyoming. Pa.

ELECTRICITY IN MINING.

Within the last twenty years the mining trade has grown to such enormous proportions that it may be regarded as one of the foundations of wealth in the United States. The wheat crop is not more important than the output of our coal, iron, gold, silver and copper mines. In order to facilitate mining in all its phases engineers have acted upon every practical suggestion which seemed to lead to a reduction in the cost of obtaining either of the above-mentioned minerals. The great Anaconda mine of the West, with its huge electrolytic refinery, hav-

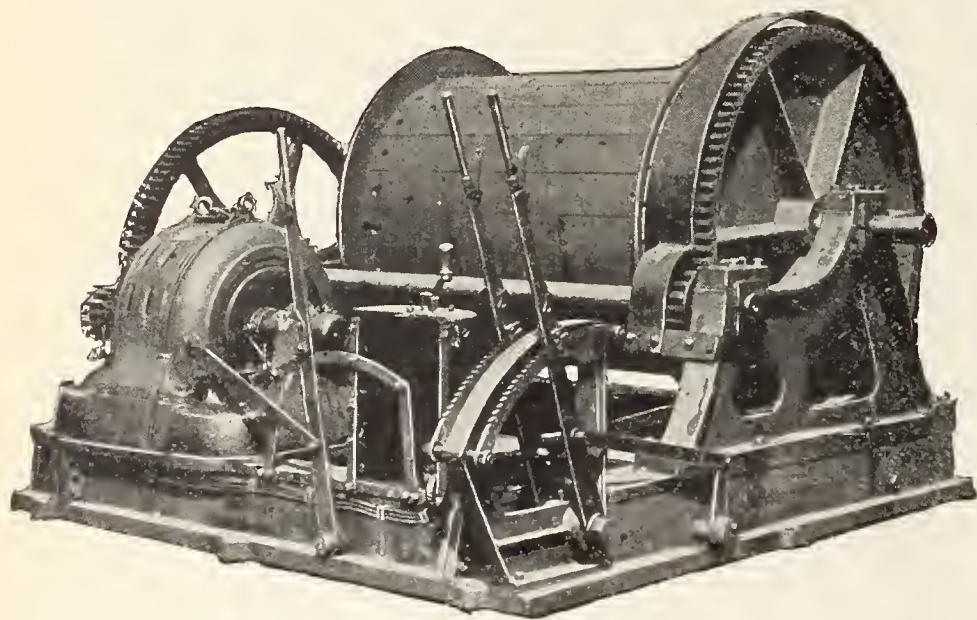
ing a capacity of fifty tons of pure copper a day, is an example of the crystallization of a valuable idea.

In coal mining electric drills perform their work with dispatch and efficiency, and for pumping and in many cases for fusing mineral products, experience has taught us that of all flexible and most easily applied forces electricity stands foremost. The mineral resources of the United States and of its practically newly annexed territory, Cuba and the Philippines, are such that the total output will be increased by a large percentage. In these

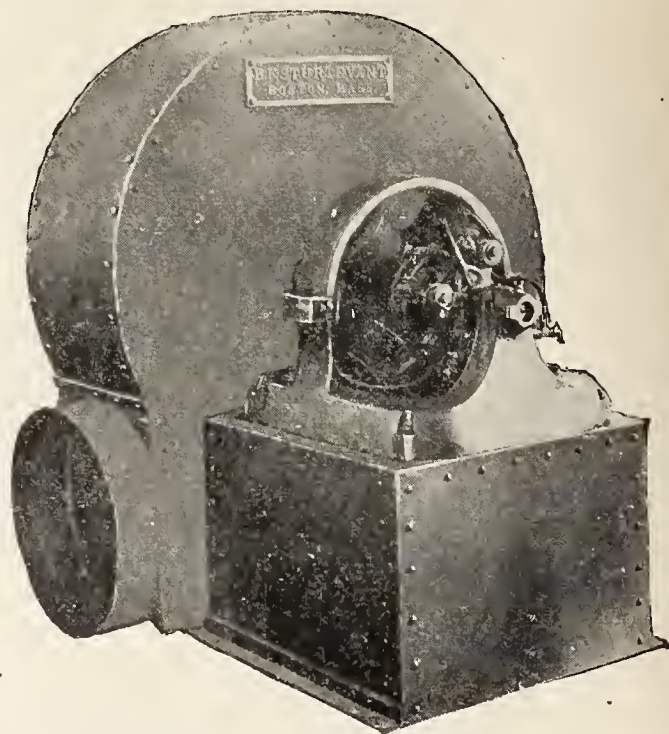
cases the old-fashioned and almost primeval methods of mining hitherto followed will give way, in the face of American enterprise, to the newer, better and more economical methods which the free use of electricity entails.

In the practice of mining, machinery is required for pumping, drilling, transporting, lifting, refining and melt-

atively speaking, extremely efficient machines. The attention any electrical or mechanical device receives in a mine is the very least it could possibly receive under any circumstances. The general class of laborers entrusted with the care of working machinery in the mine itself are never above the average intelligence, consequently their



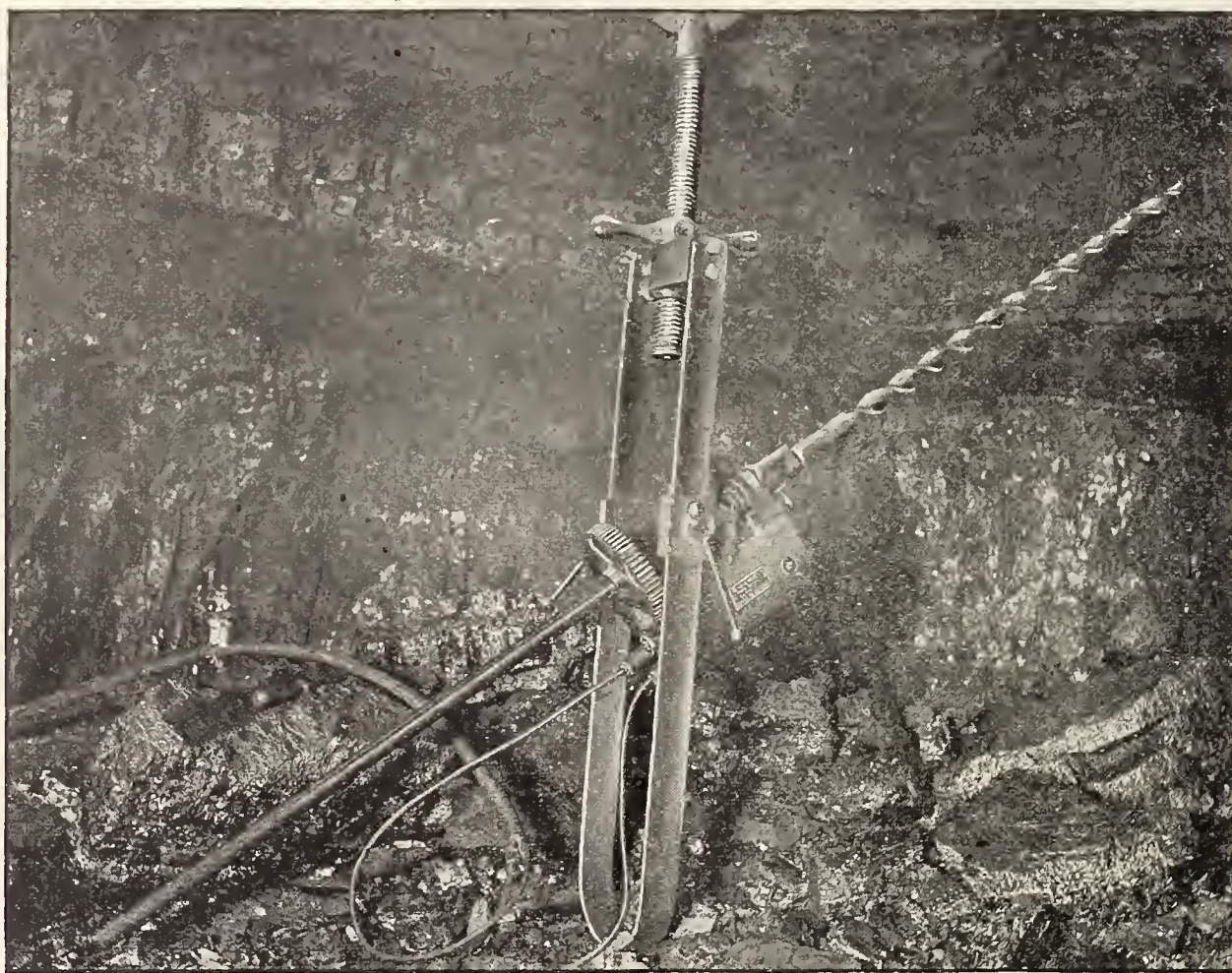
Hoist and Induction Motor, Pleasant Valley Coal Co., Pl. Val., Utah.



Blower with D. C. Motor.

ing the mineral products. Each of these departments of work can be, to a large extent, successfully carried out by the substitution of electricity for whatever power has been previously used. In mining, as in any other field of engineering, economy and quick work are the two

patience and skill in repairing are of a rather limited character. To the owners of a mine the great question to be answered is, what do I save by using electrical machinery? and the answer to be given is this: that provided the power is cheap enough, being obtained from some distant



Electric Coal Auger Drill.

factors of prime importance. By economy we would mean not a saving bought at a large expense, and by quick work not dispatch that involves the use of cumbersome or complicated machinery.

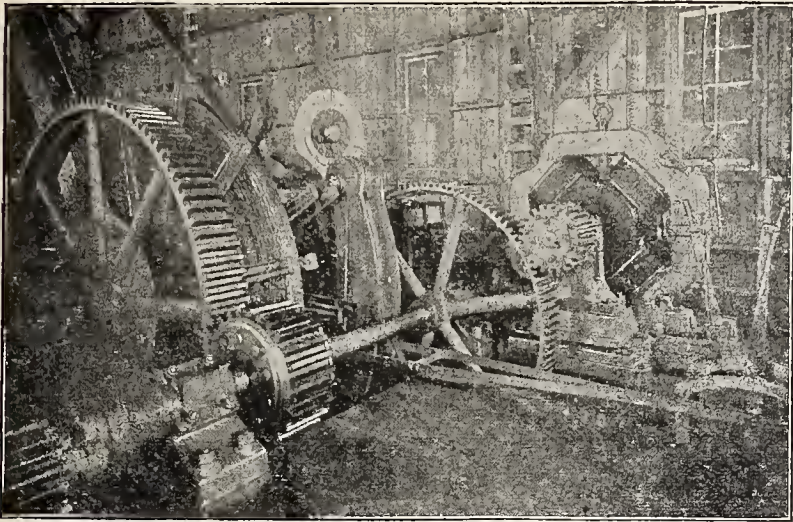
The electric hoists, electric pumps, drills, fans, coal cutters, locomotives, etc., that are used in mines operated by modern machinery, are extremely durable and, compar-

transmission plant or generated on the premises, electric pumps, hoists, locomotives, and even drills, are cheaper to operate and far more convenient to handle. Then again, electricity in a mine and around the mine is practically a necessity. Electric lights, whether arcs or incandescents, are the only means by which its gloomy interior is illuminated sufficiently to remove the great danger

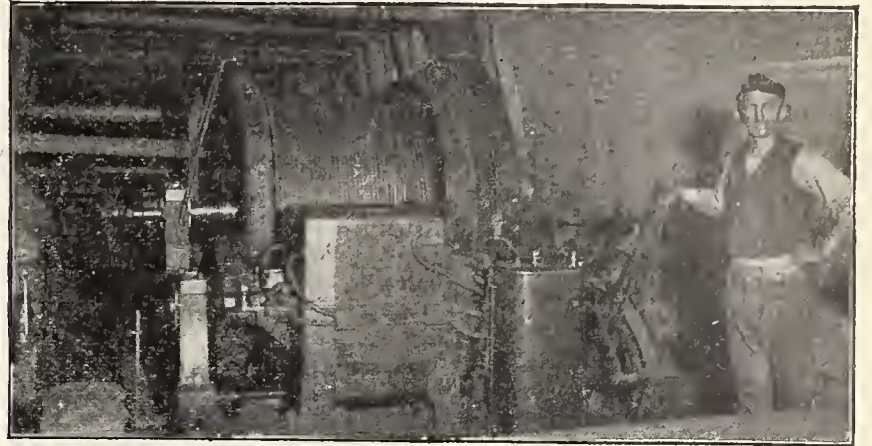
constantly present of fatal accidents to those more careless than discreet.

In reference to the transmission of power it may be said that the mining industry has been the incentive

operations to be carried on in an isolated spot, inaccessible as far as the transportation of fuel is concerned, but supported and entirely dependent upon a waterfall or power installation situated miles and miles away.



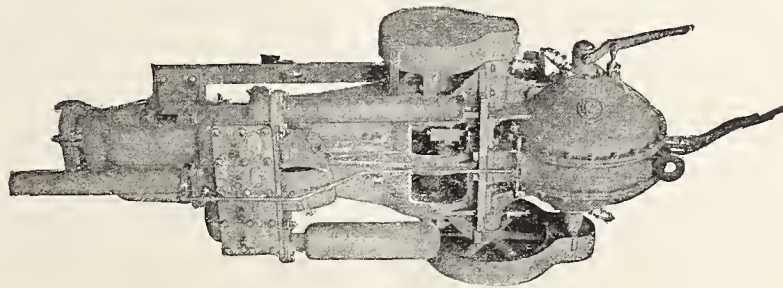
Double-Reel Hoist, 100 H. P. Motor, Free Silver Shaft, Aspen, Colo.



Electric Hoist with G. E. Motor, Lehigh Valley Coal Co.

through which the engineering profession have turned their attention seriously to this class of work with an eye to its commercial importance. The frequency with which mining centres become busy towns in which the original

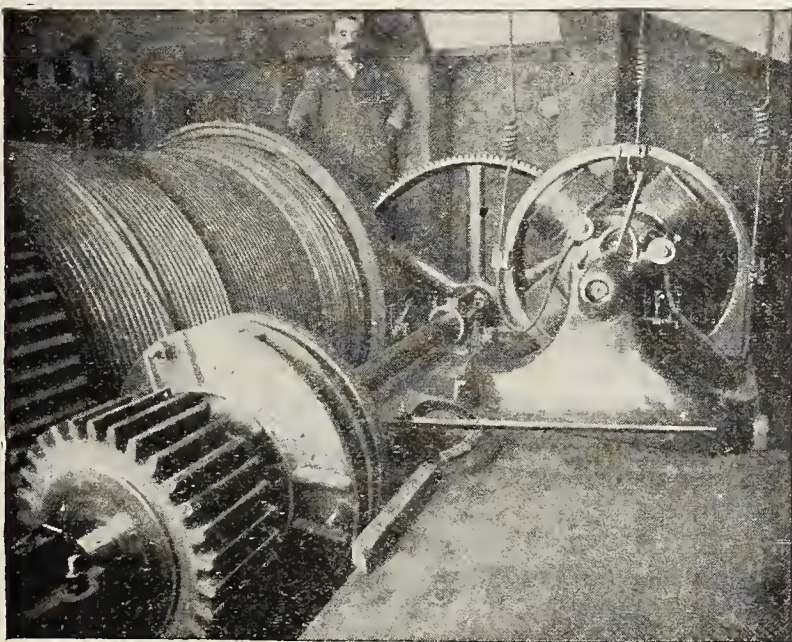
In tunnelling into the mountain sides in search of a vein the use of electrically-driven fans for preserving the hygienic conditions by driving a great blast of air forward without heating it makes the application of electricity in



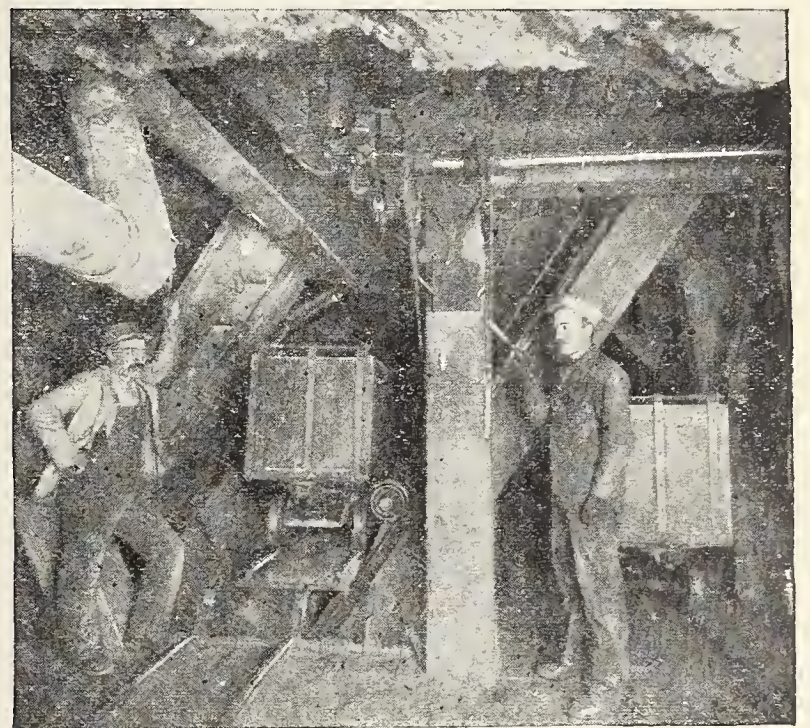
Sucking Pump, 20 H. P. Ind. Motor.

occupation gives way to others of an agricultural or foreign industrial nature can be readily understood and believed by viewing the map of the western coast of the

such a case indispensable as an important adjunct. Hence it is seen that for lighting, ventilating, hoisting, drilling and transporting, electricity has become the able and



Alta Argent Mine, Aspen, Colo., Hoist and Motor.



Alta Argent Mine, Aspen, Colo. Top of Incline. Motor in room above.

United States. It must not be forgotten, however, that the extreme flexibility of an electric system of power transmission would be useless if it were not for the great advantages offered by the ready adaptability of an electric current when generated in the polyphase form for the running of motors in direct connection with hoists, pumps, blowers and many other varied types of electrical machines. Consequently it becomes possible for mining

successful competitor of steam and compressed air through which dividends may increase, accidents be prevented and lives saved.

Savannah, Ga.—Edison Electric Illuminating Co. has purchased site for its proposed electric plant. An electric light and power plant, to cost \$150,000, will be erected immediately.

ELECTRIC LIGHTING.

THE NERNST LAMP.

The development of the incandescent lamp has reached a certain stage beyond which further improvement will involve a radical departure. To increase the efficiency of the electric lamp without decreasing its life or affecting its durability has been of late one of the greatest of modern problems.

The Nernst lamp, a description of which is published in "Science," has received considerable attention in the columns of a German paper. The "Frankfurter Zeitung" contained recently a very interesting account of Prof. Nernst's new electric lamp. As information on this subject has heretofore been so difficult to obtain, a brief abstract from this article may be of interest to readers. As has been previously announced, Prof. Nernst employs

employment of a cheaper substitute for the platinum is also announced, though the name is not made public. In operating, either an alternating or direct current is used.

(Signed) H. MONMOUTH SMITH.

Hampden-Sidney, Va.

THE STORAGE BATTERY.

AN ELECTRIC ACCUMULATOR PLANT.

According to R. B. Ritter, in "L'Electricien," the electrical generating plant of Fribourg, which has replaced the original teledynamic installation, is driven by water-power obtained from the River Sarine, and supplies electrical energy on the three-wire direct-current system to the town of Fribourg, distant about 1,500 meters. Two turbines are used, driving four Thury dynamos, with

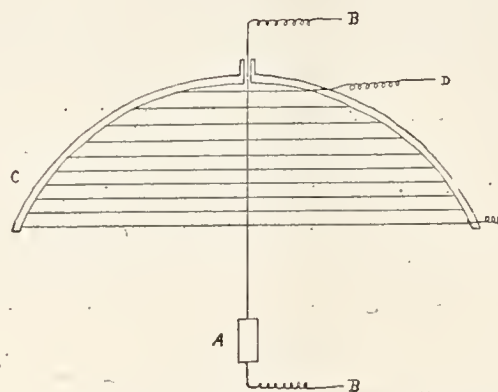
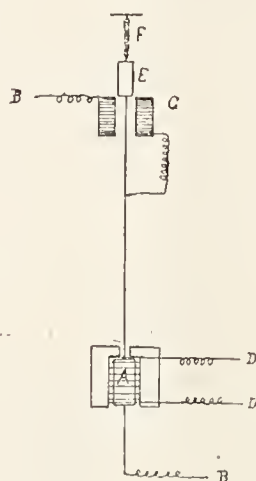


FIG. 1.



magnesium oxide for the illuminating material, which, at ordinary temperatures, is a non-conductor, but when heated to a sufficiently high degree (and herein lies Prof. Nernst's discovery) becomes a perfect conductor and emits a brilliant white light. The preliminary heating of the magnesia, A, Prof. Nernst accomplishes by placing it in the focus of a reflector, C, as seen in Figure 1. On the inner side of the reflector is a spiral wire of platinum, D, which, when brought to incandescence by a current, produces heat sufficient to render the magnesia a conductor; a current is then passed directly through the oxide by the wire, B, and that in the spiral is shut off.

A complicated form of lamp is seen in Figure 2. Here the magnesia, A, is placed within a cylinder, C, which also encloses a platinum spiral, D. As soon as the incandescent spiral has heated the magnesia sufficiently a current passes through the oxide by the wire, B. Within this circuit is a coil, G, which, upon becoming magnetic, draws down the iron bar, E, thus lowering the now incandescent magnesia from within the cylinder. Upon breaking the circuit the coil loses its magnetism, and a spring, F, raises the iron bar and magnesia to their former position.

As advantages over the ordinary incandescent lamps, Prof. Nernst claims that the same amount of light can be furnished at one-third the cost, and, as the magnesia allows of being heated to a much higher degree than a carbon filament, a purer light is obtained. The successful

a total capacity of 500 kilowatts; there are two distribution networks, one for motor supply at 700 volts across the outers, and one for lighting at 300 volts across the outers. In order to cope with any increase in the demand, two batteries of accumulators have been installed in the cellars of the Town Hall, where also the feeders and mains terminate. The cells are of the Theryc-Oblasser type, each plate being inclosed in a sheath of perforated celluloid, which supports the active material in place. There are 83 elements in each battery, having a capacity of 2,600 ampere hours at a discharge rate of 130 amperes, or 1,400 ampere-hours at 400 amperes, with a fall of pressure of 10 per cent. Each element consists of 50 plates, 250 mm. by 200 mm., contained in two glass cells, and weighing 138 kg. in all. As the maximum pressure obtainable from the lighting generators is 175 volts, a number of the cells are cut out of circuit when the main batteries are charged, and these cells are separately charged by means of a 50-H. P. Lundal motor run off the 300-volts circuit, which drives two charging dynamos. The latter are protected against reverse currents by automatic switches.

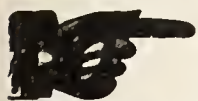
The discharge is regulated by the Trumpy system of automatic gear; relays connected by pilot wires with the distributing network actuate regulating switches, which cut out or add cells as required to keep the pressure constant.—Ex,

The Electrical Age.

ESTABLISHED 1883.

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ELECTROSTATIC GENERATORS.

The use of static electricity has more than once been attempted for industrial purposes with little or no success. For automatic gas lighting, no doubt seems to arise as to its efficiency, but in broader fields of work its application fails absolutely. Professor Trowbridge has shown by sketch a method of utilizing Leyden-jar or condenser discharges for electric lighting. These charges are originally produced by an electrostatic generator driven in the ordinary manner by motive power. The idea is to use the oscillations of the leyden jars through a finely-wound primary. Around this is wrapped a secondary of heavier wire connected to a bank of lamps. The question arising in such a case would be as follows: What is the output of the electrostatic generator in comparison with the horse-power applied? Were it merely as a matter of experiment the information would be received with great gratification by many scientists. The high efficiency of the electro-magnetic generator, the dynamo, is generally accepted as being between 90 and 100 per cent. in large-sized machines. What it would be with a machine more purely a dynamo, in the sense of causing no internal transformations of a magnetic nature, is diffi-

cult to conclude *a priori*, but an inference might be made of a most favorable nature on account of the extreme simplicity of electrostatic machinery.

Invention has followed such steps ever since man has been occupied with that fascinating art. The greatest inventions are the simplest, as they represent, as a rule, the first crystallization of basic principles. The high potentials now utilized on transmission of power lines will, if they continue to increase, compare very favorably with the static discharges of large Leyden jars. One advantage the use of Leyden jars involves is the charge and recovery, without chemical change, of all the energy stored away. In addition it may be said that condensers are now largely used for a variety of purposes. Their technical features of construction are thoroughly understood, and in comparison with earlier practice are made infinitely superior and much larger.

The close of this century has shown a great familiarity with high pressures by electrical engineers. This is, of course, due to the enormous number of transmission plants that have and are being erected. It may be that the science will bear fruit sufficiently to turn some one's attention to static generators as possible sources of commercial electrical energy.

ROTATING MAGNETIC FIELDS.

The experiments of Arago were of such supreme importance to the commercial world that there is a possibility, had they never been made, progress would have been retarded for at least a score of years and investments exceeding twenty millions of dollars never have been made. From Arago's spinning disk, first set into rotation in 1825, there came into being in rapid succession devices to which we owe the present form of the rotary magnetic field motor. Faraday's disk machine, Sturgeon's researches, the efforts of Le Roux, Willoughby, Smith, Guthrie and Boys, etc., quickly established the true meaning of rotating magnetic field and eddy currents in copper disks moved in or exposed to a varying magnetic field.

Mechanical rotation was actually produced spontaneously by De Touvielle and Lontin, whose apparatus did not differ materially from such of the simpler forms of mechanism in use at the present day.

Walter Bailey has been credited with the invention of the first polyphase motor, which he exhibited in 1879, but investigation shows claims which seem to be made in all the principal cities of the world by various scientific men.

The first value accorded an idea is not always a proof either of its practicability or future importance. It requires persistent and patient effort to clothe it with the form best adapted to the end in view. Tesla's work, dating from the years '87 to '91, gave an impetus to polyphase current work which must be recognized as having been vitally important, commercially and electrically. It affected the future of transmission work to an extent that admits of no limitation and brought into existence a system and class of machinery radically different from anything that had hitherto been suggested.

The rotating magnetic field produced by polyphase currents in its many industrial applications covers a vast field no less important than that created by Watt, Fulton and Stephenson.

Monroe, La.—The Mayor may be addressed for information concerning proposed construction of electric-light plant, for which bonds will be issued.

Kissimmee, Fla.—J. M. Bailey is interested in the proposed construction of electric-light plant.

Fredericksburg, Va.—A new electric-light plant is to be established.

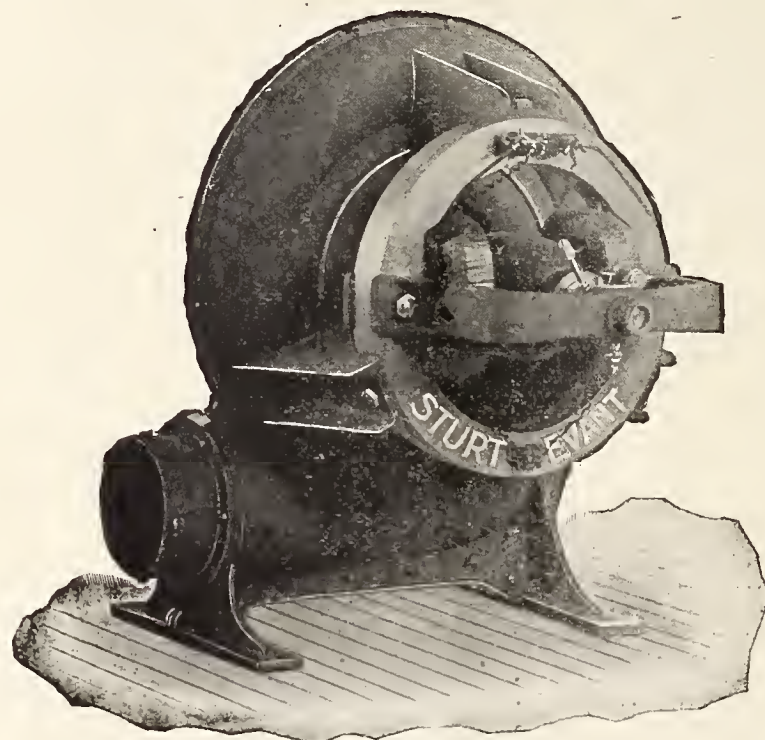
ELECTRIC VENTILATION.

STURTEVANT ELECTRIC FANS.

The ventilation of buildings has developed into a science since the introduction of electric motors and the sale of electricity to consumers. The hygienic benefit of fresh air need not be discussed, as it is universally admitted that this apparent luxury will soon become a necessity. In fact, in many establishments blowers are indispensable articles of use, without which business would be

The commutator segments are of drawn or rolled copper, and the armature is of the toothed drum type, with modified Siemens winding. The brush holders have the reaction feature and are self-adjusting, while the brushes themselves are of fibre graphite, which requires a minimum of attendance.

In Fig. 2 is illustrated a steel plate fan designed for ventilation and operating at pressures of one oz. per sq. in. and under. The rotative speed is comparatively low. A cast iron plate with projecting lugs holds the motor and

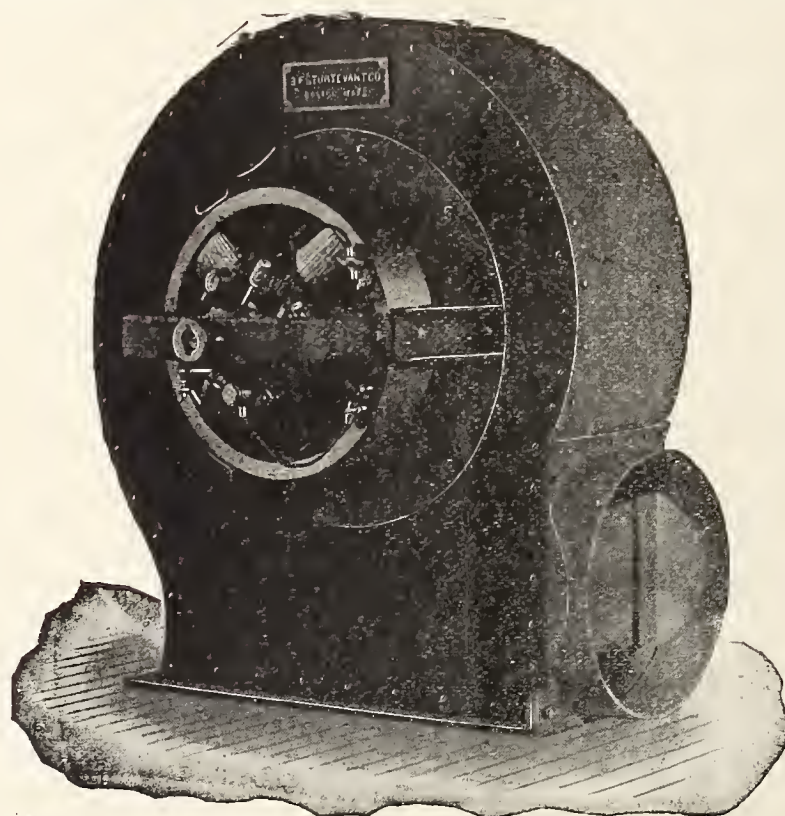


Sturtevant Electric Fan.

interfered with and losses sustained of so serious a nature as to make an investment in electric blowers a trifle in comparison. The two electric fans described in this article are manufactured by the B. F. Sturtevant Company,

is secured to the fan side. The ring in this type is of wrought iron, the motor is multipolar, and the bearings are two in number, with ring oilers supported in yokes.

The motor is a toothed ring mounted on a brass



Sturtevant Electric Fan.

Boston, Mass., with offices at 131 Liberty street, New York.

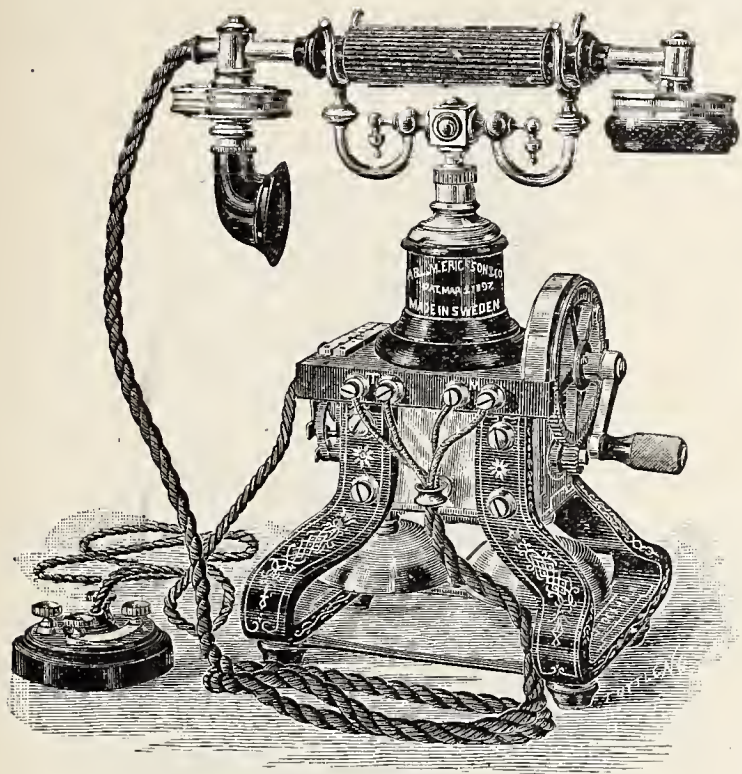
The fan illustrated in Fig. 1 is of the steel pressure type, designed for producing pressures from four oz. per sq. in. and upwards, and requires operation at high rotative speed. The motor is supported and centred by three projecting lugs turned to fit the motor ring. This ring is of wrought iron, and the motor, as will be noted, is of the bipolar type, with two bearings carried in yokes and provided with ring oilers.

spider, to the front end of which is secured the commutator. This commutator, which is of pure rolled or drawn copper, is of exceptionally large diameter, thus giving a large radiating and contact surface. The brushes and holders are of the reaction and self-adjusting type, and thus make it possible to secure perfect operation. The entire arrangement is such as to cause the motor to project as little as possible from the side of the fan casing, thereby making it compact and reducing the floor space.

TELEPHONIC.

FAMOUS SWEDISH TELEPHONES.

Telephone construction abroad has reached a high stage of perfection. The receiver of Alexander Graham Bell and the original transmitter derived from the principle of Hughes' microphone have undergone many modi-

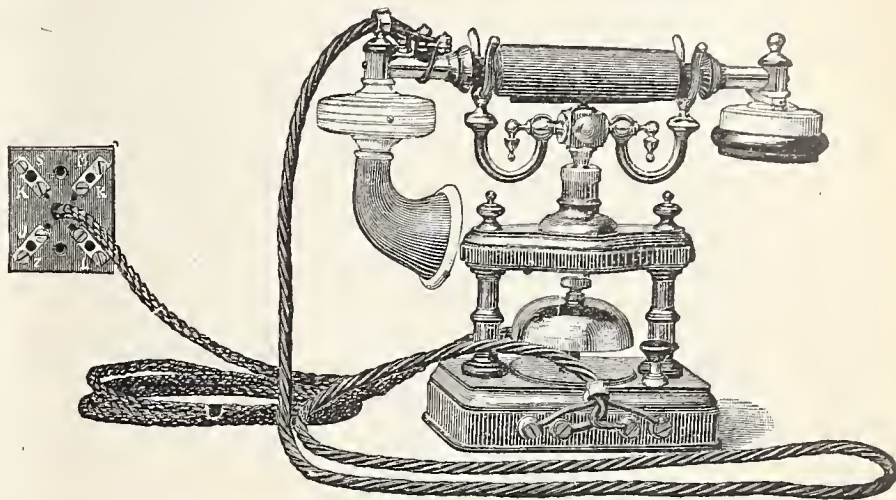


Ericsson's Swedish Desk Set.

fications. The transmitter has been improved upon by the inventor Ericsson until the audibility of sound conveyed through its means is so pronounced and the syl-

A. B. L. M. Ericsson, of Swedish fame. The receivers and transmitters, telephone system complete, have made his name a byword among telephone people through their great success on the market.

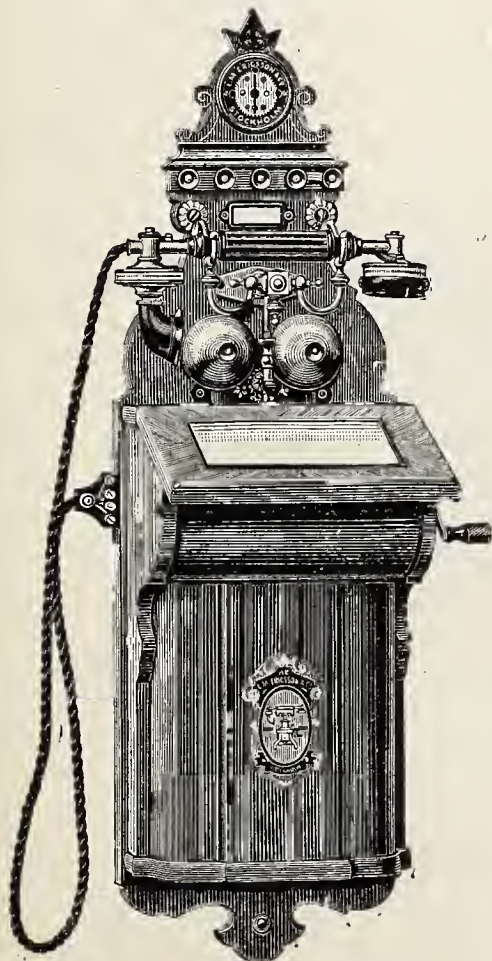
The first prizes were awarded to the Ericsson Telephone Company at Paris, in 1881; Madrid, 1883; Vienna, 1884; Stockholm, 1886; Copenhagen, 1888, and Chicago 1893. The telephone outfits and telephone accessories illustrated are sold by the Ericsson Telephone Company of 20 Warren street, New York city. They are the genuine Ericsson goods, differing slightly from the imported article in the style of wood-work, which is made



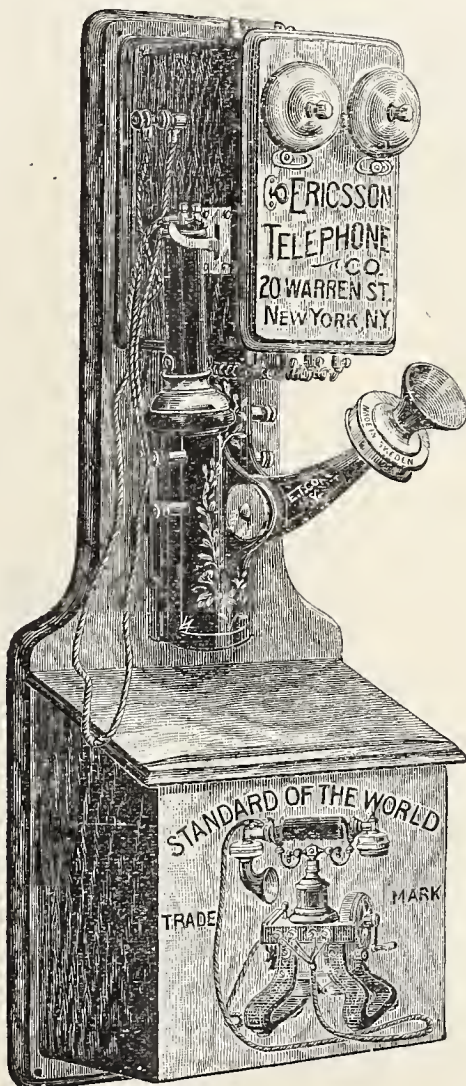
Ericsson's Swedish Battery Call. With Bell.

thoroughly American in appearance. But the telephones themselves, the working parts, are imported direct from Sweden.

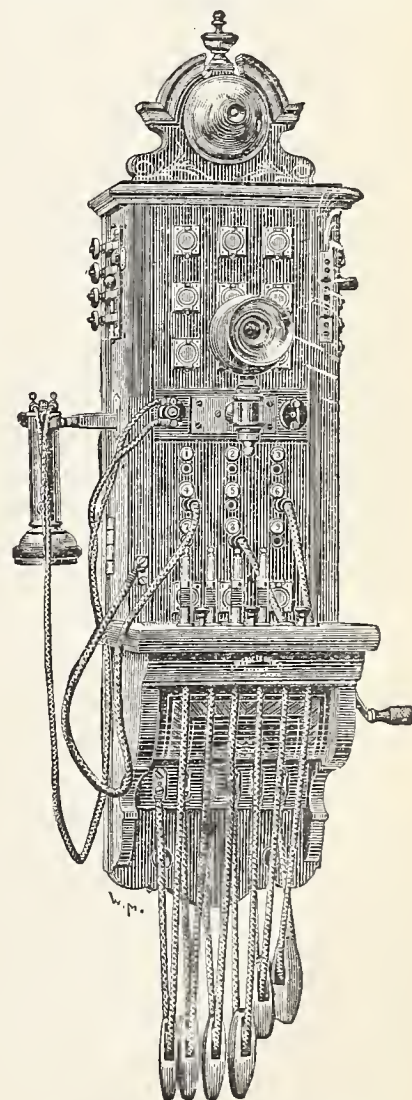
One of the best products of Ericsson's persistent labor is the Swedish coal-grain microphone. This transmitter is absolutely perfect and has acquired so great a reputation in this country and abroad that it is regarded as the



Ericsson's Samson Set for Long Distance Work.



Standard Long Distance Wall Set, with Adjustable arm, fitted with Ericsson's Swedish Coal Grain Microphone and Double Pole Receiver.



Ericsson's Switchboard.

labification is so distinct that little remains to be perfected in this respect. The inventor referred to is Mr.

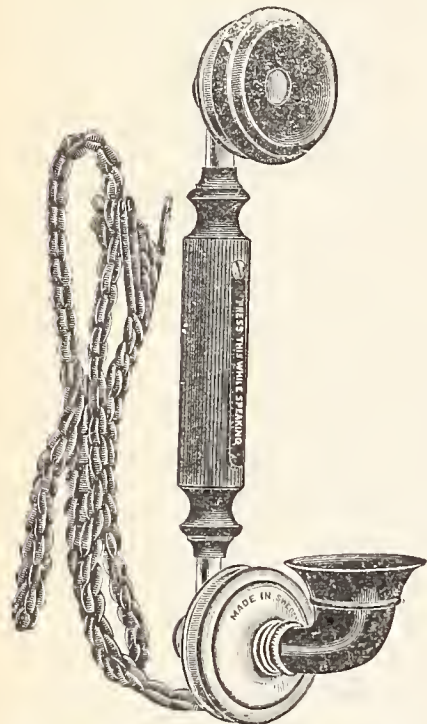
ne plus ultra of 'phones. It can, of course, be used in connection with any outfit, with perfect ease. In this

instrument the construction is such that bad contacts and packing will not occur and adjustment is not necessary. In combination with the double-pole receiver the quality of sound is so excellent that there is little left to be desired.

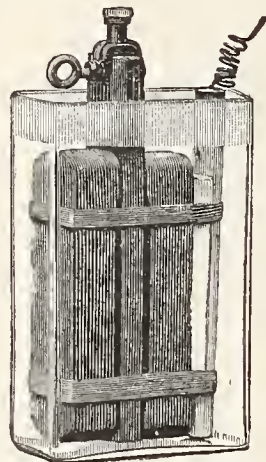
The Ericcson Telephone Company manufacture the famous coal-grain hand micro-telephone with contact fastenings. This can be held to the face suiting the ear and mouth at the same time. The desk set, consisting of stand, transmitter and receiver, has in addition a twen-

their number 622 switchboard outfit, built in all sizes, both trunk line and multiple for grounded or metallic circuits.

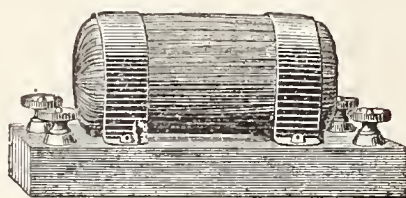
In conclusion, it may be stated that they have gotten up a portable testing set with battery included. It is called the fault-finding lineman's set. It possesses neither transmitter nor receiver. It represents the acme of convenience and the most desirable quality of portability. The genuine Ericcson telephones are stamped "made in Sweden," also with the signature as follows: "A. B. L. M.



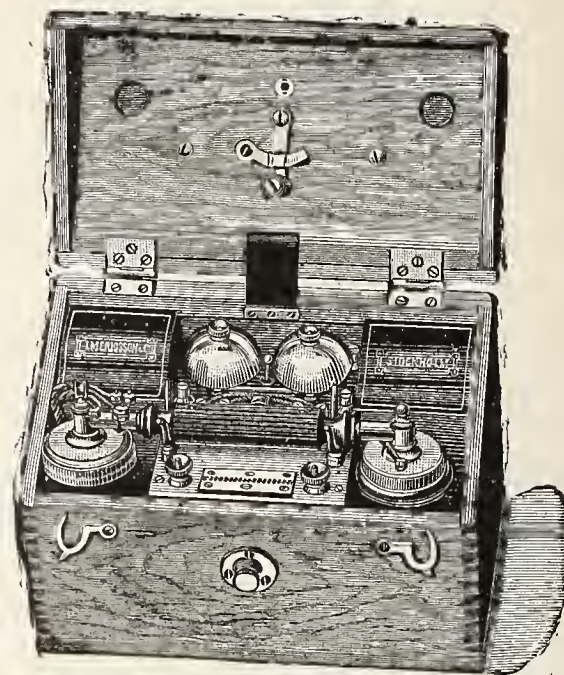
Ericcson's Coal Grain Hand Microtelephone with Contact Fastenings.



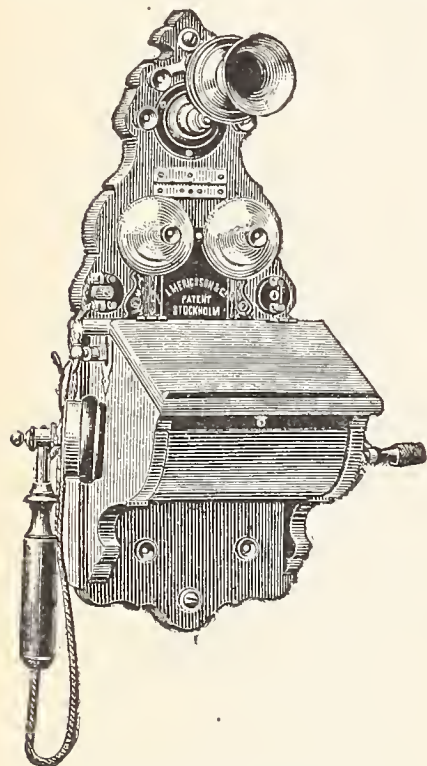
Ericcson's Swedish Samson Battery.



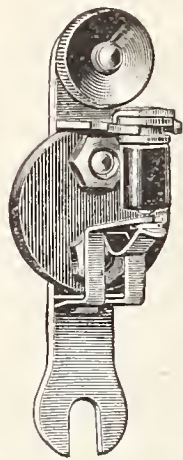
Ericcson's Swedish Transformer.



Ericcson's Swedish Portable Testing Set, Complete with Battery Enclosed.



Ericcson Wall Set.



Ericcson's Swedish lightning protector for high and low tension current.



Ericcson Desk Telephone.

ty-five thousand ohm magneto. This outfit is remarkable above all for its clearness in speech both in sending and receiving. The battery call and bell telephonic outfit is similar in construction, with the exception of the magneto.

This company sells the transformer used in circuit work for transforming the grounded into metallic or metallic into grounded circuits. The Ericcson Swedish long-distance exchange sets are beautifully designed. They operate to perfection, require little or no attention and present from an æsthetic point of view an exceedingly handsome appearance. The combination sets are made in a variety of styles, with and without battery box.

Ericcson & Company. Patented Oct. 29th, 1895." The last date is to be found in all coal-grain microphones.

Potsdam, N. Y.—Rocket River Telephone Co. has been incorporated by J. A. Crawford, M. S. Crawford and Fred C. Ward; to operate a telephone line in Potsdam. Capital stock, \$6,000.

Somerville, Tenn.—W. D. Scruggs may be addressed concerning erection of proposed electric light plant.

Ewan, N. J.—City Clerk may be addressed concerning contemplated electric light plant.

STRAY CURRENTS.

ELECTRIC INSTALLATIONS ON THE PACIFIC SLOPE. During the past eight years fifty-two distinct companies in the Rocky Mountain district alone have installed electric power machinery for mining and ore reducing purposes. The plant comprises 62 generators, aggregating 7,988 kilowatts, and 135 motors, aggregating 4,816 horse power, operating every variety of mining and milling machinery.—Ex.

COMMERCIAL ELECTROLYSIS OF WATER. The chief difficulty in the electrolytic preparation of hydrogen and oxygen lies in the complete separation of the gases. In Garutti's process he uses a metallic diaphragm inserted in the cell, but not reaching the bottom, so as to allow sufficient space for the passage of the liquor from one electrode to the other. A plant of thirty-two cells, yielding daily 30 cu. m. of oxygen and 60 of hydrogen, has been working for six months, and the gases are sufficiently pure for commercial purposes, the oxygen containing about 1.5 per cent. of hydrogen, and the hydrogen only a trace of oxygen. This process is operating very satisfactorily and economically in Italy, Switzerland and Belgium, yielding very pure oxygen at a cost of less than half a cent a cubic foot, leaving a large margin of profit. The electrolyzer consists of steel plate cells, the bottoms of the diaphragms being provided with small apertures, allowing the electrolyte to pass through, but not the gas bubbles, thus preventing the gases from mixing.—Ex.

TROLLEY TRAVEL IN BOSTON. Boston travel on the suburban steam lines in the last four years is estimated by the State Railroad Board to have decreased about 10 per cent., while the corresponding trolley travel has increased 25 per cent. It runs this way all through New England.—Ex.

VESTADIUM. Vestadium is a recently discovered white metallic alloy, of a beautiful appearance and great strength. It seems to meet with as quick and general an acceptance as was the case with aluminum. It is said to be firmer and much more practical than any other known metal of equal specific gravity. It is claimed to be composed chiefly of an aluminum alloy, and only weighs one-third as much as aluminum of the same size. Furthermore, it is said not to rust, to withstand sulphuric acid, to take a fine polish, never to tarnish, and once polished, never to require cleaning.—Ex.

FIRES IN SHOP WINDOWS. In view of the numerous fires that have recently taken place in shop windows in Germany, the German police have issued a notice containing the following recommendations, says "The Electrician:" All glow lamps used in shop windows should be provided with globes, shades or wire guards, or so arranged that they cannot come into direct contact with inflammable material. If the lamps are surrounded with silk or other fabrics, the covering must not envelope the lamp completely, so that the air can circulate between the lamp and the covering. Arc lamps should be provided with ash trays of metal instead of the glass ones usually employed. Conducting wires in the windows should be well insulated.—Ex.

MAGNETIC SURVEY OF THE GLOBE. A conference of scientists, held at Bristol, Eng., in connection with the British Association for the Advancement of Science, has just concluded its labors. The question for deliberation before this body, wherein Charles A. Schott, of the coast

survey, represented the United States, concerned the preparation of a plan for a systematic survey of the entire globe, and the deliberation of the conference resulted in a general recommendation for that purpose. The principal work of the conference centred in the wider questions involving magnetic observations; their at present unsatisfactory distribution over the globe, and their inadequacy as regards numbers. The United States is in a position to take a most important step in the advancement of our knowledge of terrestrial magnetism by establishing and maintaining a well-equipped magnetic observatory on one of the Hawaiian Islands. Their position is unique, being central to a vast unexplored, or, rather, magnetically unknown, region, and well adapted for the special study of the modifications which the diurnal and secular variations of the magnetic needle are supposed to undergo in consequence of a surrounding ocean as contrasted with a continental surface.—Ex.

OSMIUM FILAMENTS FOR ELECTRIC LAMPS.

Two months ago we drew attention to the new discoveries with which Auer von Welsbach and also Nernst are credited. The subject has exercised the press a great deal, and may continue to do so, since the new Welsbach patents threaten to establish another monopoly. Welsbach's claims are of the broadest kind. The metals proposed are osmium alone, and osmium combined with platinum, iridium, ruthenium, etc., coated with alloys or with oxides, etc. The filaments are manufactured by depositing osmium from its volatile tetroxide on a very thin platinum wire, which is afterwards evaporated by passing a strong electric current through it, or by mechanically applying layers of osmium and cements to a wire or vegetable fibre by electrolytic depositions, etc. The osmium, as metal or oxide, may also be employed in an emulsion with collodion, which is spun and denitrated like artificial silk. In addition to the oxides, the osmium sulphide is recommended. The thin coating of thoria, which is likewise proposed, is to be applied in several layers, and each coat is to be calcined.—Ex.

PRODUCTS OF THE ELECTRIC FURNACE.

MANUFACTURE OF CALCIUM CARBIDE.*

There are no official statistics as to the annual output of calcium carbide in France, and it is necessary to estimate the amount furnished yearly by the different manufacturers. The American Consul at Havre says that these estimates vary from 1,000 to 5,000 tons a year from each factory. There are at present ten factories engaged in the manufacture of carbide of calcium in France. Two are at La Bathie, and one each at Séchilienne, Froges, Chapareillan, Lancy, Notre Dame de Briançon, St. Beron, Bellegarde, and Crampagna. Four factories are under construction. They will be situated at St. Etienne de Maurienne, Epierre, Serres, and Chute de Giffre. They will be able to produce, when running at their full capacity, from 2,500 to 3,000 tons per year. The wholesale price of carbide of calcium in France is from 350 to 400 f. per ton, exclusive of cost of packing. The cost of packing is 4.50 f. per iron drum containing 110 lb.; 6 f. per drum of 220 lb. The carbide of calcium manufactured in France is guaranteed to give 300 cubic litres of gas per kilo. The output is constantly increasing, and the supply is fully equal to the demand. The retail price of the article is from 55 f. to 60 f. per 100 kilos., not including packing. There are two villages in France completely lighted by acetylene, by the Société Franco-Espagnole du Gaz Acétylène, of 81, Rue St. Lazare, Paris. They are Alzonne, in the department of Aude, a town of 1,506 inhabitants, and Saurat-par-Tarascon, in the department of Ariège, a place of 3,024 inhabitants.

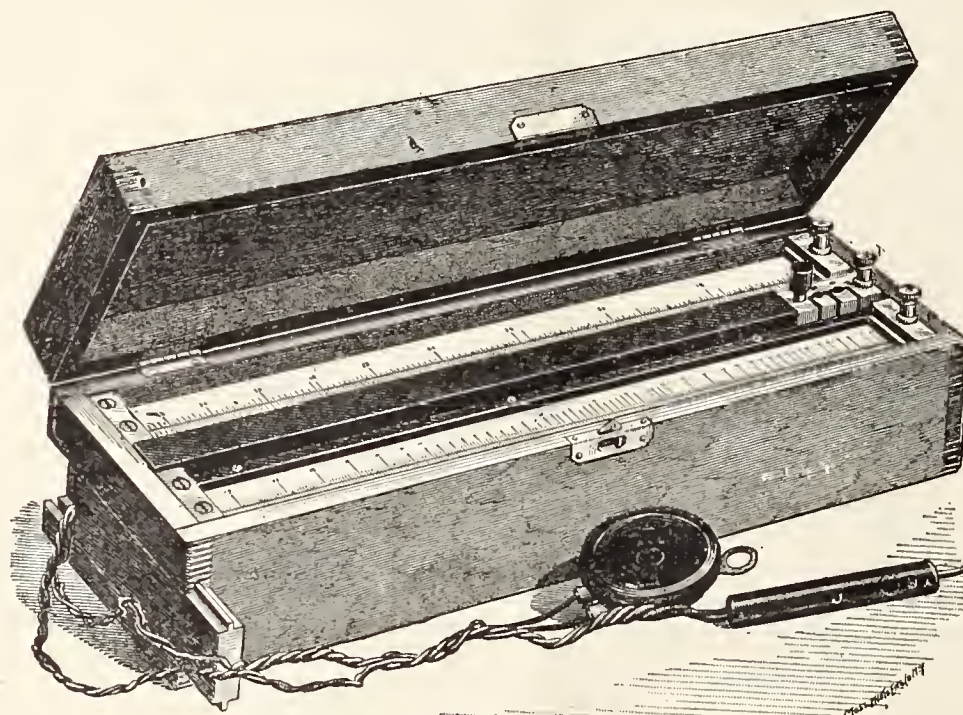
* Trade Journal's Review.

ELECTRICAL MEASUREMENTS.

THE DIRECT-READING OHMMETER.

A most interesting and practical instrument is the direct-reading ohmmeter, by means of which resistances may be accurately and readily measured. There are many occasions where a ready means of measuring resistance would be greatly appreciated by electrical men; for instance, those in care of an electric light plant and for station and street railway use, as well as laboratory purposes. From such as these the ohmmeter will receive a hearty welcome.

The instrument is used as follows: A telephone attached to it is placed over the ear, the battery key depressed, and the light wire, which is stretched over the scale, is touched in different points by the stylus till a point is found where there is no sound in the receiver. When the resistance has been found the receiver becomes



The Direct-Reading Ohmmeter.

silent, and the reading indicated by the stylus gives the number of ohms. This instrument is supplied with a battery which will last six months, if frequently used; longer otherwise. Its great convenience will and is making it exceedingly popular.

The ohmmeter is manufactured and sold by the American Electric Specialty Co., 123 Liberty street, New York.

CONSTITUTION AND RESISTANCE OF MERCURY.

At the recent congress held by La Société Allemande d'Electrochimie at Leipsic, a paper was communicated by M. Liebenow with regard to the constitution of mercury. From his experiments it appears that the electrical resistance of the alloys depends principally upon the molecular grouping, i. e., upon the number of atoms forming the molecule of the solid substance. In the case of solid mercury the molecular grouping is extremely complex, but in the gaseous condition it is probably monoatomic. It is remarkable that, whereas for most pure metals, including solid mercury, the temperature coefficient for resistance is in the neighborhood of 0.004 per 1° C., whilst for liquid mercury the coefficient is only 0.001. Liquid mercury appears to be a mixture of monoatomic molecules, and the more complex groupings characteristic of the solid condition.

Royal Oak, Mich.—City Clerk may be addressed concerning establishment of electric light plant.

INSULATION.

OXYLINE.

That great hopes seem to be based upon oxyline (the recently discovered substitute for india-rubber) is evident from the report which the French Consul, at Dusseldorf, sends to the "Moniteur Officiel du Commerce." He says that this new material, which is obtained by the oxidation of linseed oil, mixed with an agglutinant substance such as crushed jute or other almost valueless wastes of textile materials, is now being made in factories established at Piesteritz, near Wittenburg, on the Elbe. These factories, "Oxyline Werke," belong to a joint stock company, founded by the Leipsic Bank, which has bought the patent for Germany and Austria-Hungary. If this new artificial material can be shown to be suitable for the numerous purposes indicated, the consul thinks it certain that the price of caoutchouc cannot be maintained at its

present level. A fall of any importance in the near future cannot, however, be expected, as time will not have allowed of the extended production of oxyline. It remains to be ascertained if, and to what extent, it can replace caoutchouc, and what results it will give as to durability. It is proposed to use oxyline for machinery packing, cable coverings, and insulating plates in the electrical industry, as well as for floorcloths in place of lino-leums.—Ex.

ELECTRIC LIGHT AND POWER.

POWER REQUIRED FOR MACHINE TOOLS.

It is stated that at the Baldwin Locomotive Works there are 215 motors, the aggregate horse power of which is 700, for driving cranes and machine tools. To keep these in motion and repair requires the services of only two men, with a third of the time of another man; the annual cost of labor and material being about £500. Smaller machines are grouped, and large machines have each separate motors allotted to them. A 70-inch wheel lathe requires 1.5 h. p. to run it empty, and 6.2 h. p. to run it under the full load of two cuts $\frac{1}{2}$ -inch deep on a 56-inch wheel. A frame slotter, with 18-inch stroke, taking a heavy cut, absorbs 10.3 h. p.; when light, it requires only 2.3 h. p. A large double frame planer, with two $\frac{1}{2}$ -inch cuts, absorbs 11 and 21.6 h. p. empty and loaded. A drill requiring 2.85 h. p. when drilling a $2\frac{1}{4}$ -inch hole, uses only 0.97 h. p. when running light. To bend steel plate 11-16 inch thick by 10 ft. 6 inches long takes 19.8 h. p., while the empty machine requires 3.5 horse power.—Ex.

AMONG THE SOCIETIES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 129th meeting of the Institute was held at 12 West 31st street, Wednesday evening, November 23d, President Kennelly in the chair. The paper of the evening on "The Design of Transformers," by F. W. Carter, of London, England, was read by Prof. W. S. Franklin, of Lehigh University, in the absence of the author. It was discussed by Messrs. Franklin, W. B. Jackson, Wolcott, Henshaw, Torchio and others.

At the meeting of the Executive Committee in the afternoon the following Associate Members were elected: Cleveland Abbe, residence 2017 I street, N. W., Washington, D. C.

John Cassidy, Honolulu, Hawaiian Islands, U. S. A.
James Francis Cosgrove, 631 Madison avenue, Scranton, Pa.

Donald Hume Fry, Blue Lakes City, Col.
James Hamilton, 54 State street, Boston, Mass.
Bernhard Hoffman, 15 Dey street, New York City.
Harry D. James, 100 Buena Vista avenue, Yonkers, N. Y.

S. L. G. Knox, Montclair, N. J.
Howard Wallace Leitch, 373 Madison street, Brooklyn, N. Y.

R. W. Lohmann, 1387 Madison street, Oakland, Cal.
C. Stowe Reno, 62 Baymillen street, Cincinnati, Ohio.
R. H. Sperling, Victoria, B. C.
James Wilkinson, 862 South 19th street, Birmingham, Ala.

A. Wilford Zahn, Manhattan Building, St. Paul, Minn.
The following Associate Members were transferred to Full Membership:

Franklin Robert Anson, secretary and manager, Salem Light & Traction Co., Salem, Oregon.

Sidney Hand Browne, consulting electrical engineer, Baltimore, Md.

A. E. Brooke-Ridley, agent and electrical engineer, Siemens & Halske Electric Co., San Francisco.

The Committee on Co-operative Research, having completed the first stage of its work, has sent various collegiate electrical engineering departments an explanatory circular submitting twenty-seven subjects for investigation.

TIPS ON TRADE JOURNALS.

A PARABLE.

And it came to pass that after he had advertised his goods there came unto him great multitudes from all the region round about and did buy of him. And when his competitors saw it they marvelled among themselves, saying: "How be it that this man is busy, while we loaf about our doors?" And he spake unto them, saying: "Verily, verily, I say unto you, in this fast age of push and rustle, it is easier for a camel to enter the eye of a needle than for a business man to flourish without advertising."—"Printers' Ink."

Business News.

SPECIAL EXPORT COLUMN.

TOTAL ELECTRICAL EXPORTS FOR WEEK ENDING NOV. 29, 1898, \$42,423.00.

New York, N. Y. Nov. 29, 1898. The following ex-

ports of electrical material are from the port of New York for the week ending this date:

Brazil—653 packages electrical material, \$7,002.

British East Indies—147 packages electrical material, \$4,456.

Bremen—15 cases electrical material, \$3,000.

British Possessions in Africa—47 cases electrical material, \$1,805.

Chili—9 cases electrical material, \$403.

China—28 cases electrical material, \$1,417.

Hong Kong—12 cases electrical material, \$860; 14 cases electrical material, \$108.

Hamburg—102 cases electrical material, \$11,006.

Liverpool—1 case electrical material, \$50; 28 cases electrical machinery, \$585.

London—128 cases electrical material, \$8,900.

Southampton—2 cases electrical machinery, \$104.

U. S. of Columbia—3 cases electrical machinery, \$1,650.

Venezuela—357 cases electrical material, \$1,127.

TELEPHONE CALLS.

Memphis, Tenn.—The Cumberland Telephone & Telegraph Co. will build a structure for offices and exchange headquarters.

Christianburg, Va.—Aaron Graham proposes the construction of a telephone line to Roanoke.

Snow Hill, Md.—The Worcester County Telephone Co. is being organized by Dr. Geo. W. Bishop, Clayton J. Purnell, John F. Moore, Thos. M. Purnell, W. S. Powell and others; to construct a telephone system.

Vicksburg, Miss.—The Cumberland Telephone & Telegraph Co. will extend its telephone system, increase exchanges from 600 to 1,000 and make other improvements.

Paducah, Ky.—Henry Biederman will construct immediately telephone system, for which he obtained franchise.

Spencer, Iowa.—The Citizens' Telephone Co. has been incorporated, with a capital stock of \$10,000.

Albany, N. Y.—The New Rochelle & Westchester Telephone Co. has been incorporated, with a capital stock of \$150,000. Its directors are G. W. Sutton and Joseph Claudet, of New Rochelle; Frederick R. Kellogg and Horace A. Connor, of Brooklyn; Heinrich Meyer, of New York, and John H. Scofield and David G. Whiting, of Grandview. The company proposes to operate telephone systems in New Rochelle and vicinity, and to extend its lines to New York City, Boston, Buffalo and other intermediary places.

POSSIBLE INSTALLATIONS.

Richmond, Ky.—The Mayor may be addressed for information concerning electric light plant, for which franchise has been asked.

Clarence, Mo.—H. J. Williams, Mayor, may be addressed concerning establishment of a \$5,000 electric light plant of 1,000 lights capacity.

Fredericksburg, Va.—City Clerk may give information concerning proposed erection of an electric light plant.

Gainesville, Ga.—James P. Edwards, of Augusta, Ga., contemplates the erection of an electric light plant in Gainesville.

NEW INCORPORATIONS.

Jersey City, N. J.—Cooke's Electric Match Co. has been incorporated by George W. Sandford, Emma M. Cooke and Edward Sandford; to manufacture lighting devices. Capital stock, \$50,000.

Red Lake, Minn.—The Red Lake Electric Light Co. has been incorporated by Marcus Johnson, Emma F. Marshall and Luman C. Stone. Capital stock, \$8,000.

New York City.—The incorporation of the Otis Elevator Company has been announced. This corporation is a combination of the Otis, Sprague and various smaller elevator interests, and is capitalized at \$11,000,000.

Macon, Mo.—The Trans-Mississippi Electric Light & Power Co. has been incorporated by Col. F. W. Bles, J. F. Schaefer and Charles E. Roel; for the purpose of establishing and managing electric light and power stations. Capital stock, \$30,000.

STREET RAILWAY NEWS.

Flint, Mich.—Steps are being taken to build an electric line from Flint to Long Lake, to connect with the Corunna-Owosso road.

BUSINESS CHANCES.

Pittsburg, Pa.—Westinghouse Electric & Manufacturing Co., with a capital stock of \$13,400,846, has been licensed for business in Illinois, with \$29,000 capital.

FLASHES.

Oconto, Wis.—The Oconto Electric Light Co.'s plant destroyed by fire at a loss of \$60,000; insured for only \$18,000.

NEW YORK ITEMS.

Electrical supply dealers wishing to enlarge their stock will do well to write to the Standard Incandescent Light Co., 143 Centre street, for circulars.

O. Lindberg, 570 Fulton street, Brooklyn, desires to receive circulars and catalogues from manufacturers of electrical novelties and specialties. Mr. Lindberg is an electrical engineer with a large clientage and has a large store excellently located for the sale of electrical goods of all descriptions.

Mr. James H. Mason, the well known inventor and electrician, has opened up offices in the World Building, 59-63 Park Row. Mr. Mason is prepared to represent manufacturers of all kinds of electrical apparatus, having had a long and varied experience in this line of work.

Among the dealers in electrical supplies there are few who stand as high as Mr. J. Jones Jr., of the firm of J. Jones & Son, 64 Cortlandt street, in the estimation of buyers. There is no dealer more conscientious or anxious to cater to the demands of electrical buyers than Mr. Jones, and much praise is due him for his many good qualities. During the past few months Mr. Jones has been working under a great strain, due to the absence of his trusted manager, Mr. E. A. Lowe, and has spent many a day and night at his warehouses and factory, personally supervising orders and seeing that they were carefully carried out in every detail.

Mr. Norman H. Schneider, who recently severed his connection with the export department of the Western Electric Co., of this city, is now in Havana, Cuba, where he has opened up a wholesale and retail store at O'Reilly 1, for the Krajewski-Pesant Company. This company has secured the sole Cuban agencies for a number of American firms and also for the General Electric Company, of London, England, and is prepared to handle all kinds of machinery, electrical and other, tools, supplies, etc. Mr. Schneider will be pleased to hear from his old friends, and reports that his company is overhauling and restoring a number of plants in the province of Havana. Mr. Schneider, as will be known by many of our readers, is the author of "Norrie's Induction Coils."



WESTON STANDARD

PORTABLE DIRECT READING

VOLTMETERS AND WATTMETERS

For Alternating and Direct Current Circuits.

The only standard portable instrument of the type deserving this name.

Write for Circulars and Price Lists 8 and 9.

WESTON ELECTRICAL INSTRUMENT CO.
114-120 WILLIAM STREET, NEWARK, N. J.

75c.

"VULCAN" STYLOGRAPHIC PEN

75c.



"INDEPENDENT" FOUNTAIN PEN



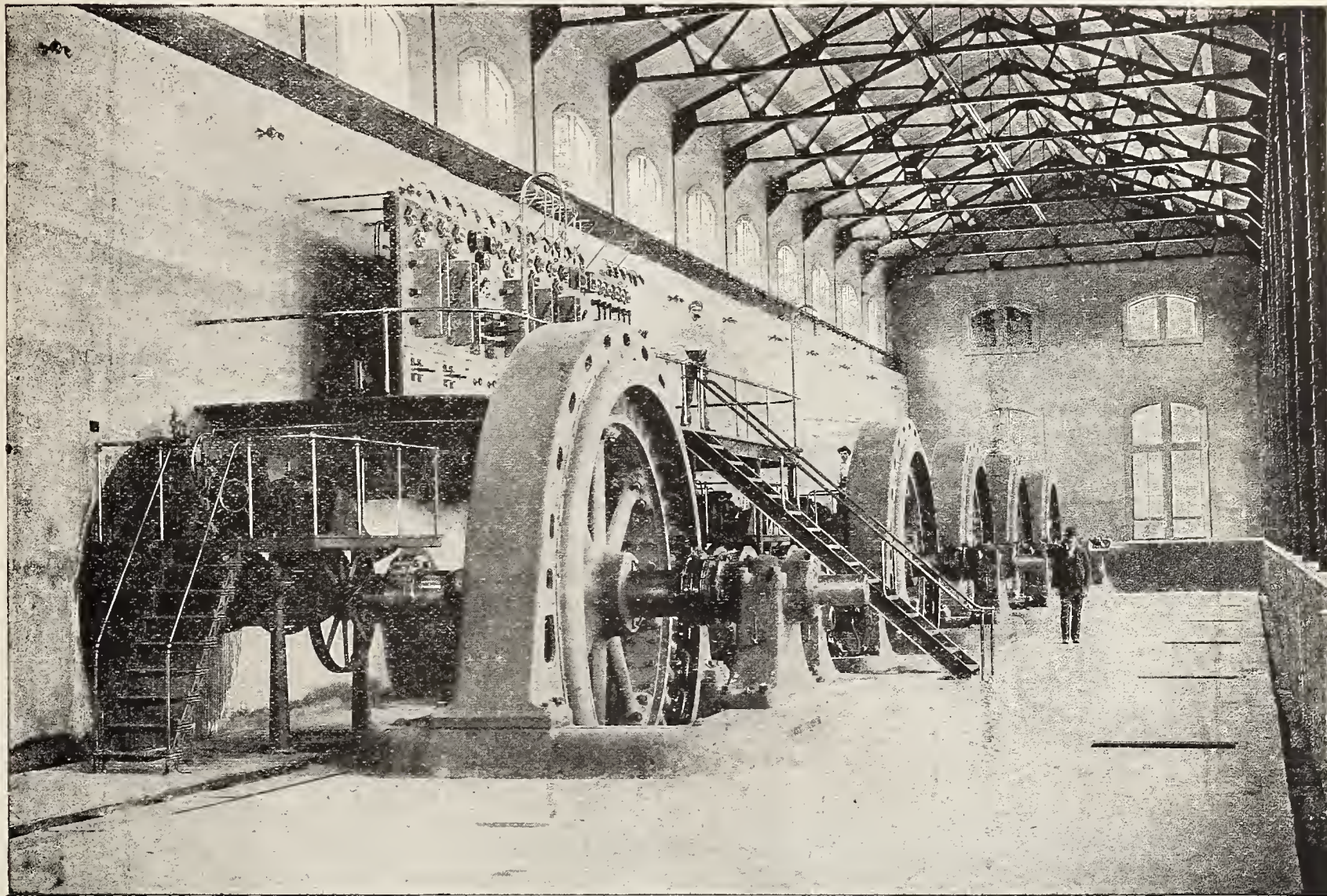
PRICE, WITH ENGRAVED HOLDER, \$2.00. SAME WITH GOLD BANDS, \$2.50.

FOUNTAIN PENS LICENSED UNDER PATENTS 260,134 AND 311,554.

Send for our New Catalogue and Discounts.
AGENTS WANTED.

J. K. ULLRICH & CO., 27 Thames St., New York.

POWER TRANSMISSION.



Interior of Power House, Mechanieville, N. Y.

THE ELECTRIC POWER TRANSMISSION BETWEEN DISTANT POINTS.

The various methods of transmitting power by means of steam, wire rope, compressed air and electricity have been carefully reviewed by some of the greatest living authorities. There was a time in the history of applied science when the selection of a system of transmitting power was a matter of the most careful consideration. A rapid review of the large installations at present in active operation will rapidly bring about a conclusion of a most definite and emphatic character. Electricity has assumed a position in the engineering world which gives it undisputed sway when the transmission of power over great distances is proposed. In our busy towns and less settled suburban districts the trolley has been a great success, and the distribution of power along these miniature transmission lines is increasing day by day until the consumption of electricity for lighting has become a perceptible item of the load at the power station. But power transmission proper between Niagara and New York or the coal fields of Pennsylvania and New York is an entirely different matter. In other words, the case that comes most closely in touch with the title of this article is one involving two widely separated centres between which a line is erected carrying power from one

to the other. According to Kapp the efficiencies of a wire rope transmission plant are sufficient to explain why cable roads change to electricity. The reasons are plainly stated in the following figures:

Distance in feet.	300	1,500	3,000	15,000	30,000	60,000
Efficiency	.96	.93	.90	.60	.37	.13

From these figures the fact may be gleaned that wire rope transmission between widely separated centres is not an interesting proposition to capitalists. By sending electricity through a line over this system, which is at its maximum about twelve miles, the efficiency of its delivery would be about 72 per cent. at its best, and about 40 per cent. at its worst. It will be well to state for the benefit of our readers that a generator, line and motor possessing respectively 90 per cent. efficiency would give a result in efficiency for power transmitting purposes of 72 per cent. It is not very difficult to send one thousand horse power to-day a distance of one hundred miles at an efficiency of 60 per cent. It is not difficult to attempt to transmit heavy power over long lines, neither is it impossible to send such pressures as sixty thousand volts safely a distance of twenty or thirty miles and deliver power with efficiency. The famous Frankfort-Lauffen

plant, which transmitted power from the Neckar River a distance of one hundred miles, is an example in which

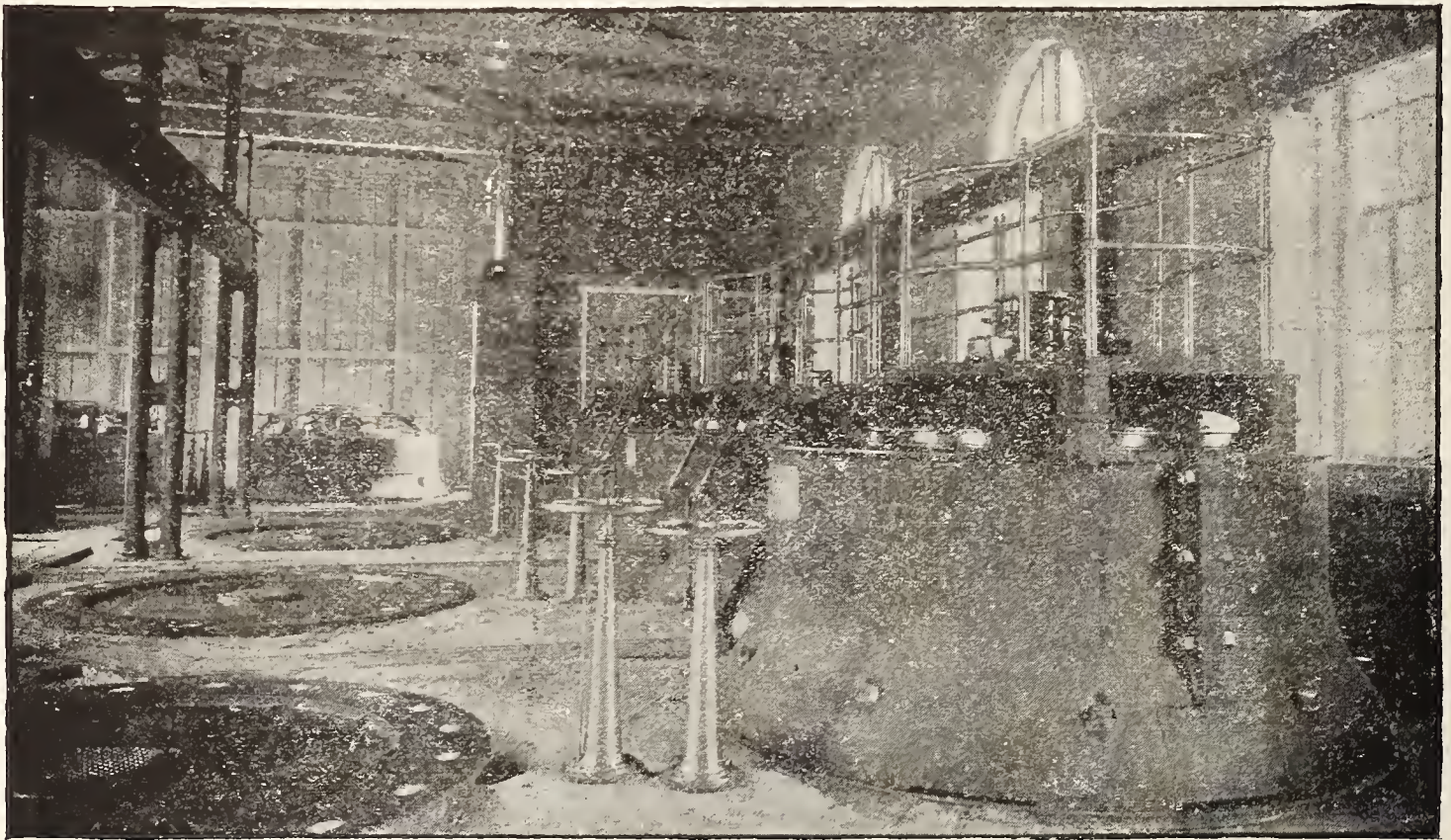
invite success. The transmission of electrical energy between widely separated centres becomes a



Interior of Electrically Driven Weave Room.

thirty thousand volts travel along the line. The efficiency is reported to have been 72 per cent. The economy of transmitting power is somewhat affected by the cost of repairs. Weak machinery is as detrimental to a plant as poor insulation. There are no continuous cur-

commercial problem of considerable significance. Lord Kelvin's rule for the size of conductors, Prof. Forbes' modification for the laying of an additional ton of copper and the citations of other authorities give us sufficient data from which to arrive at definite conclu-



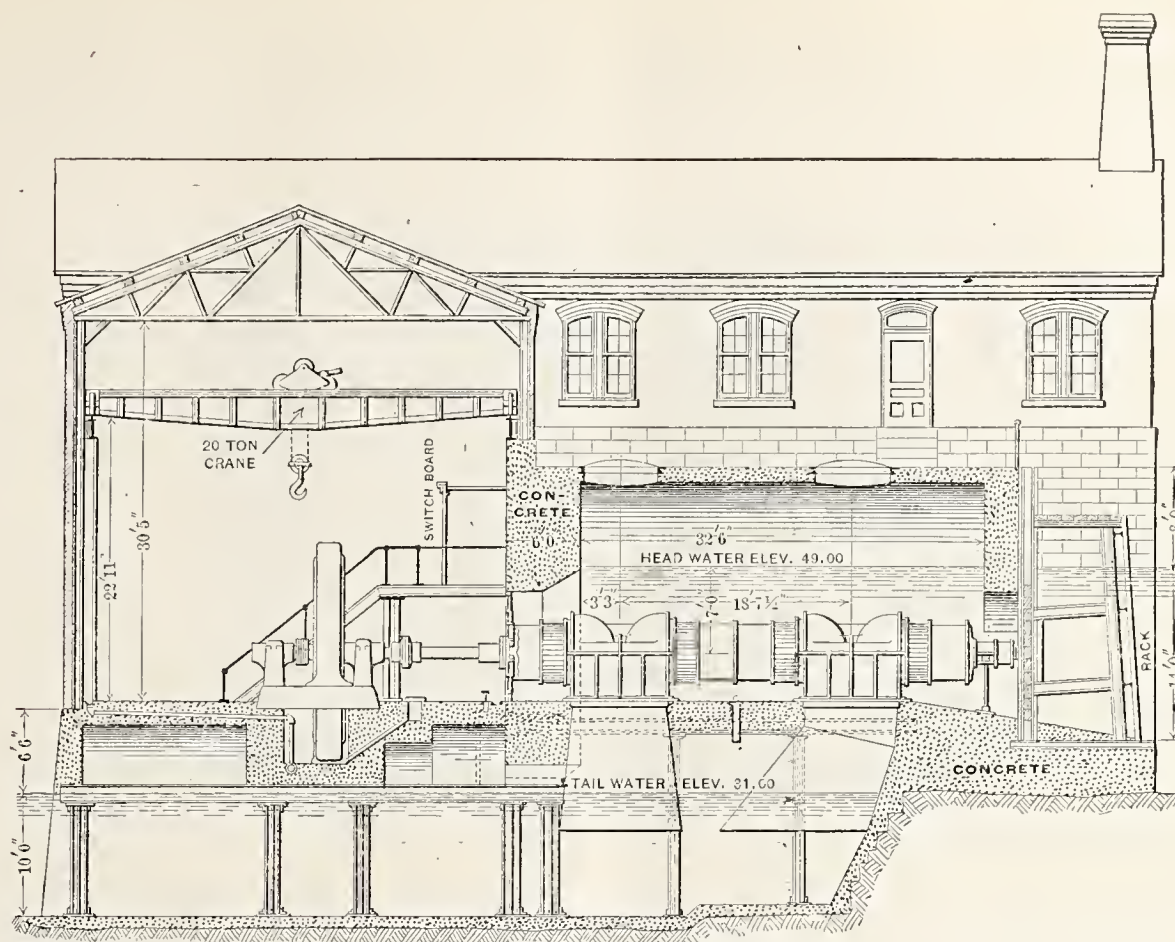
The Great Generators at Portland, Oregon.

rent generators in existence that could safely be used for high tension work—such pressures, for example, as ten thousand or twenty thousand volts; but a combination of the motor transformer polyphase generator and high-class insulators supplies elements that

sions regarding the economical transmission of electrical energy. The transmission of power is successfully carried on with a high pressure and easy transformation, efficient motors and a good line insulator. Supplied with these at their very best and most practical values the

transmission plant can hardly fail to become a well-assured success.

CALCIUM CARBIDE IN EUROPE.—It is stated that the Schukert Electrical Company of Nurnberg in Germany has completed arrangements to have in oper-



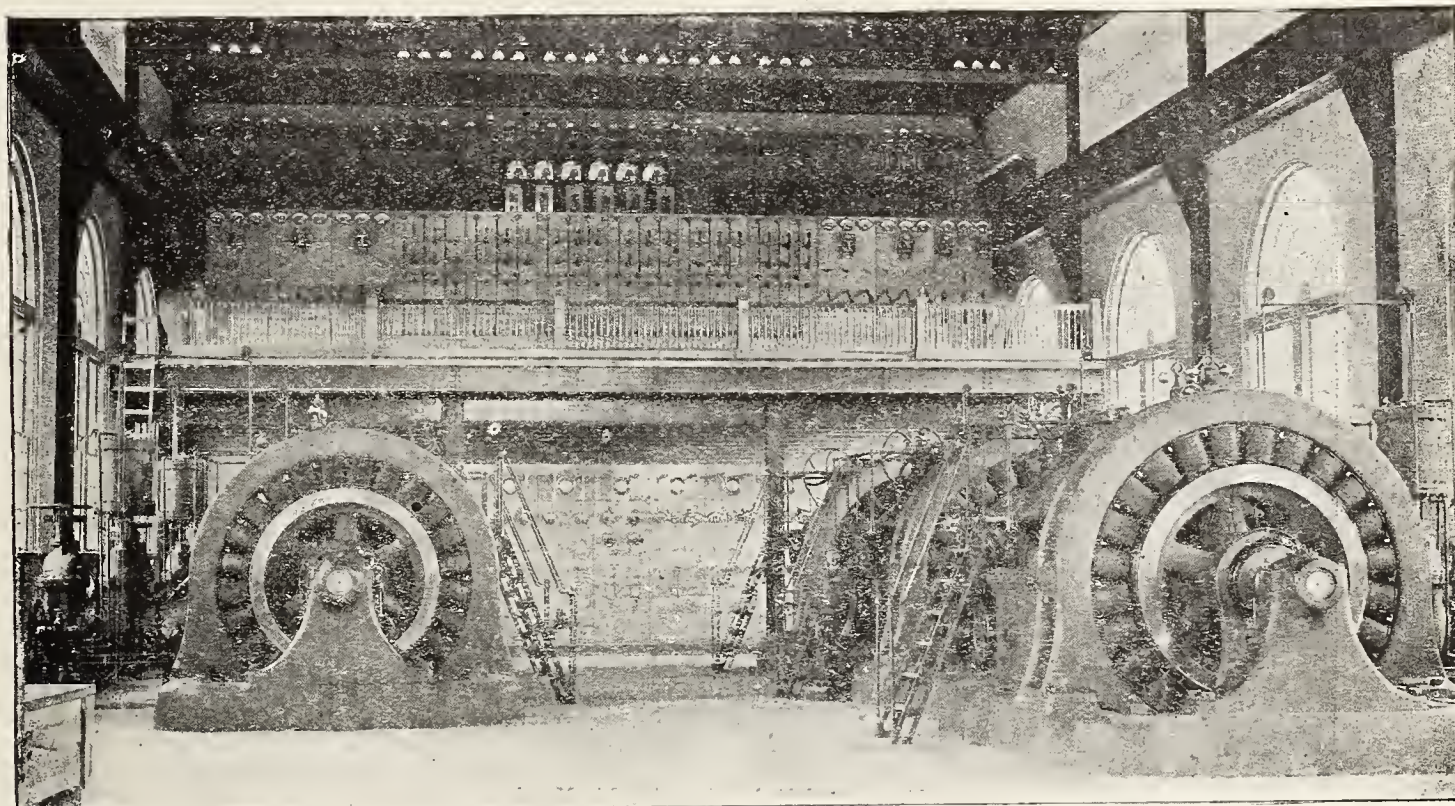
Section of Power House at Mechanicville, N. Y.

MISCELLANEOUS SCIENCE.

STRAY CURRENTS.

ARTIFICIAL RUBIES.—A patent has been taken out in Germany for the production of artificial rubies by

ation next year plants for making calcium carbide in Norway, Bosnia and Spain; in all of these the electricity required will be generated by water-power. The total yearly capacity of these works will be 20,000 metric tons of carbide. In view of the proposed increase in production, it is stated that a reduction in price of 20 marks



Interior of Pioneer Power Station, Ogden, Utah.

evaporating a mixture of alumina and chronic oxide in the electric furnace and pass the vapors, with the introduction of damp air and hydrochloride acid, into a condensing chamber, where the rubies precipitate.—Ex.

per 100 kgs. has been offered for next year, on contracts.—Ex.

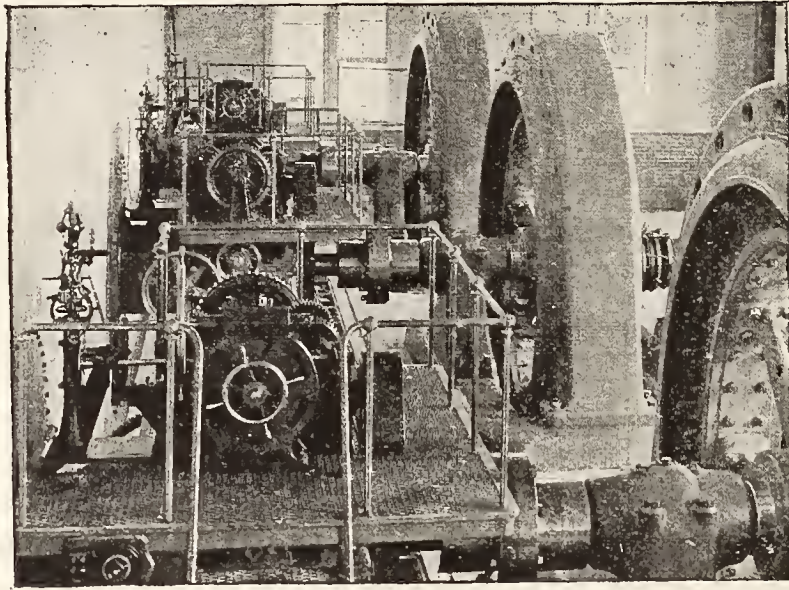
— MANUFACTURE OF VULCANIZED FIBRE.—Vulcanized fibre, which is extensively used by mechan-

ical and electrical concerns throughout the United States, is manufactured in enormous quantities in Wilmington, Del. Of five plants in the country four are located in that city.—Ex.

MAGNETIC ISLAND.—A magnetic island has been discovered in the Pribilof group, in the Behring Sea. The highest hill, Ulakiya, appears to be the centre

deck there is little liability of the latter becoming necessary."—Ex.

SINE WAVES ON OCEAN CABLES.—The Crehore and Squier synchronograph has recently been tested on the submarine cable of the Commercial Cable Company running between New York City and Canso, Newfoundland. A simple sinusoidal wave of impressed elec-



Governor, Mechanicville, N. Y.

of magnetism. The volcanic rock is decidedly magnetic, a noteworthy and significant observation.—Ex.

ELECTRICITY IN THE NAVY.—The Chief of the Bureau of Ordnance U. S. Navy, Captain O'Neill, says: "Experience has shown that guns in turrets operated by electric power can be laid upon and more accuracy made to follow a moving target than when operated by

tromotive force is expected to give higher speed on cables with the same dielectric strain as it does on overhead lines with the same impressed electromotive force.—Ex.

Crescent City, Fla.—The Fruitland Peninsula Telephone Company has been incorporated, with W. J. Pierpont, president; Dr. G. E. Walker, secretary; J. W. Miller, treasurer. Capital stock, \$800.



Dam at Mechanicville, N. Y.

steam, hydraulic or pneumatic power. There are no water pipes to freeze, no steam pipes to burst, and no delay in obtaining a full working pressure, and no troublesome or noisy exhaust pipes to deal with. A burned-out fuse can be replaced quickly or a broken wire repaired, and as the wires can be led below the armored

Jersey City, N. J.—Manhattan Microphone Company has been incorporated by John H. Mangham, Theodore J. Mitchell and Thomas A. Hutchins; for the purpose of making, buying, etc., microphones, telephones, etc. Capital stock, \$100,000.

The Electrical Age.

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THE EFFICIENCY OF MODERN TRANSFORMERS.

Some interesting problems have arisen of late in regard to the construction of transformers. By the term transformers the technical world generally refers to an alternating current device of the step up or step down order. quoting from Fleming as an authority, we find that he states that "the electrical efficiency of a transformer is defined to be the fraction or percentage of the whole energy supplied in a given time to the primary circuit which appears in the form of electric current energy in the secondary circuit." We can only attribute the present perfection of alternating current transformers or of any other form of apparatus by means of which the pressure of a line is raised or lowered to a more thorough comprehension of the elementary principles underlying the science of electricity and magnetism than existed in earlier days. The researches of Steinmetz on the subject of hysteresis, the labors of Ferranti in establishing a huge alternating current power transmission and distributing plant, the brilliant work of Tesla and Dobrowolsky in the field of power transmission by three-phase currents have stripped the science of the retarding influence of empiricism and thereby rendered the construction of not only transformers, but a great variety of alternating current machines, a simple and most definite process. However perfect a system of power transmission might be as far as the gen-

erator and line are concerned, the possibility of establishing such a system and making it a commercial success would be obviously impossible if the transformer itself possessed any inherent defects. An analysis of transformer reactions was carefully made by Professor Forbes, the recently deceased Dr. John Hopkinson, and Lord Kelvin, which brought to light many interesting facts concerning the output and economical operation of transformers in general. One of the conclusions arrived at was this: "For working economically with small frequency of oscillation large massive cores are essential, but by increasing the frequency the core mass may be diminished without loss of efficiency." The watts entering the primary coil and given out by the secondary in modern transformers differ but slightly from each other so high is the practical operating point of efficiency. Ninety, 95 and 97 per cent. are not any too high for the efficiency of well made transformers. The careful selection of iron, its proper lamination, the careful adjustment of the saturation point of the transformer and the practical means taken for rapidly dissipating any heat that may appear give in total a self-regulating, economical and exceedingly simple piece of machinery. Many of the scientific dissertations prolonging discussion through a course of weeks and sometimes months have ceased to be written on account of the definiteness that has attached itself to not only the phraseology employed, but to the meaning of certain phenomena inseparably connected with alternating current work. Such expressions as "square root of the mean square," "difference of phase," "hysteresis," etc., are not juggled with any longer, although there was a time when the use of such phrases implied a profound knowledge of the subject. But as use became abuse a general sifting took place through which many terms became obsolete and gave strength and vitality to that department of electrical engineering which lay entirely at the mercy of mathematicians and unprincipled inventors. Thousands of dollars are being invested each month in electric light and power plants. The great West, unknown to ourselves, has used its natural resources as far as possible for its development, and owes much of its life and modernness in its large cities to the use of electricity. But many plants installed there operate by machinery of the single or polyphase class, and we can rest assured that a deficient, troublesome, non-durable and unefficient transformer would have absolutely prevented either the introduction or use of what is now regarded as the most modern type of apparatus, the polyphase generator, transformer and motor.

ELECTRO-OPTICS.

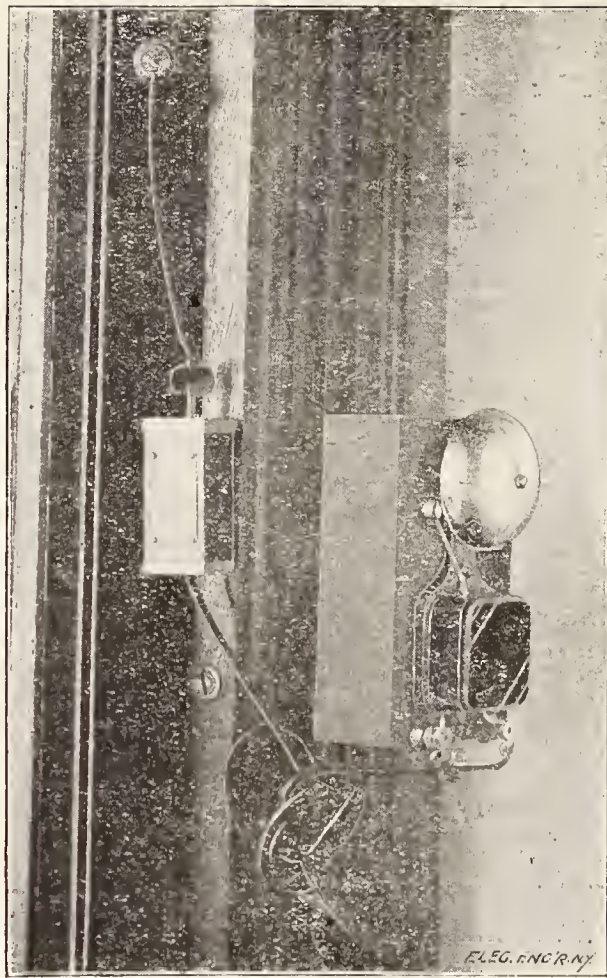
A study of electricity in its higher branches becomes more and more a study of the fundamental principles of light. With so strange a medium as the luminiferous ether, the constitution of which is comparatively unknown, it is most natural for those sciences whose higher branches blend into the metaphysical to meet at some common point of intersection. Clerk Maxwell has outlined some of the physical conditions existing in the ether when certain electrical phenomena take place. In the study of light waves a certain similarity is observed in the treatment of the subject to that which throws light upon the finer foundations of magnetic, electro-static and electro-magnetic reactions. In fact, all branches of physical science become more clearly understood as spokes radiating from the same hub. Given ether and energy, and we can play upon the framework of matter through all of nature's keyboard and develop light, heat, magnetism, electricity, and possibly numerous undiscovered variations of these. At the point where light and electricity intersect a study of the ether begins, and it is hard to tell whether the mystery of the ether will be discovered by a co-ordination of these natural phenomena or whether a better knowledge of the ether must first be obtained before our horizon of scientific investigation can increase.

ELECTRICAL NOVELTIES.

A PORTABLE ELECTRIC BURGLAR ALARM.

The well-known contractor, Mr. Charles L. Eidlitz, the president of the St. James Electric Company, 1133

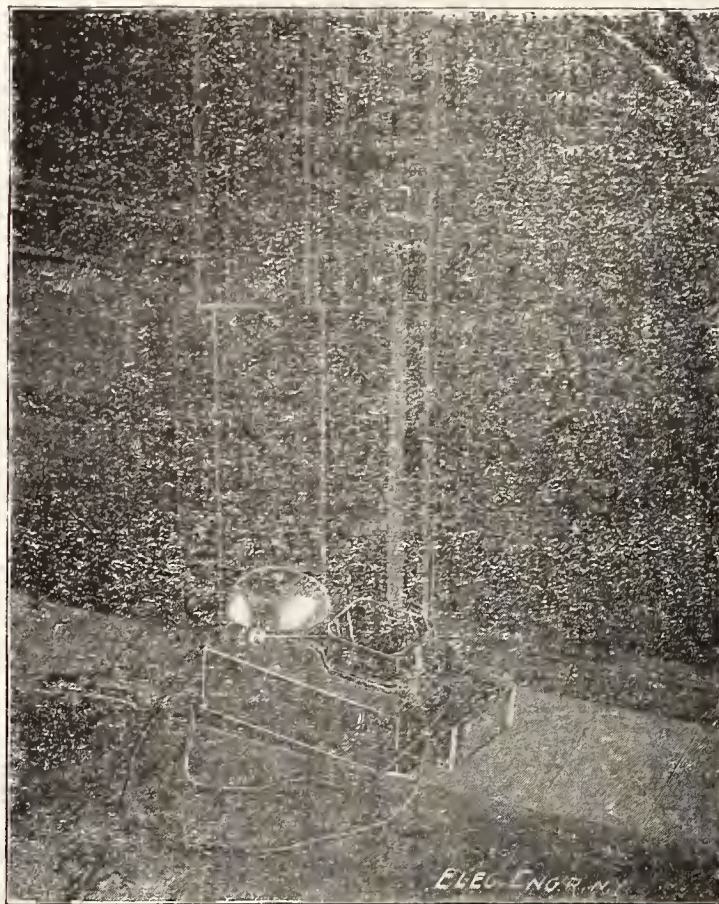
two springs are kept apart. The withdrawal of this moving separating piece by the opening of the door or window brings the springs together, closes the contact and rings the bell. This device is the acme of simplicity. Its action is positive, and can be understood by the small-



St. James Electric Burglar Alarm.

Broadway, New York City, manufacturers of the St. James burglar alarm, illustrated in these columns, realizes the practical value of this outfit as an effective, cheap and simple burglar alarm. It consists of a box contain-

est child. The readiness with which it can be adjusted, and its cheapness, make it an exceedingly popular article for domestic use as well as in factory, office or public building.



St. James Electric Burglar Alarm.

ing two dry cells, to which is attached an electric bell with two and one-half inch gong. The signalling device proper is a small wooden cylinder, within which is a moving part insulated at one extremity by which means

AN INDUCTION SEWING MACHINE MOTOR.

The Emerson Electric Mfg. Co., of St. Louis, calls attention to the fact that their improved induction sewing machine motor makes a useful and acceptable Christmas

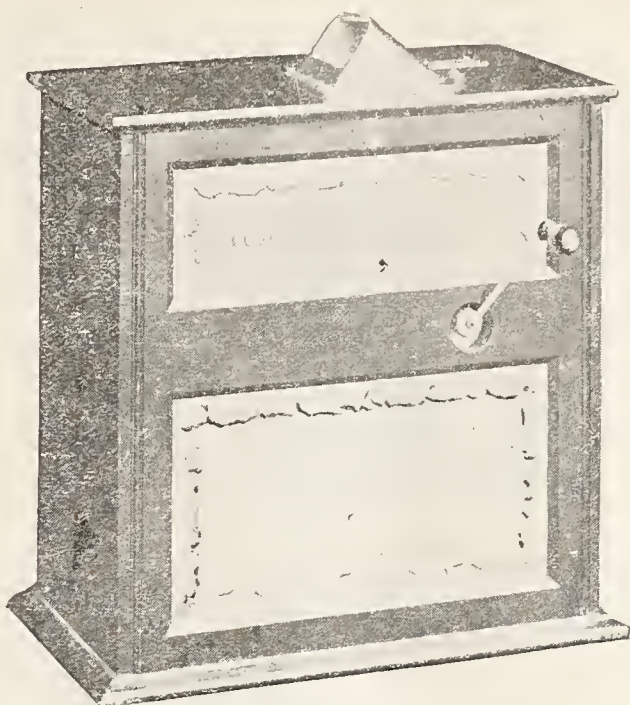
present for any housekeeper.

These motors, having no wearing part except the shaft, are particularly adapted for use by inexperienced persons, and the entire device is easily attached to any make of family sewing machine. The sewing machine is started, stopped, and speed is regulated by a slight move-

Kent, Leon P. Charpist, Charles L. Arnold and W. M. Denman. Capital stock, \$5,000.

NOVELTIES OF INTEREST TO THE TRADE.

The parlor kinetoscope, illustrated in these columns,

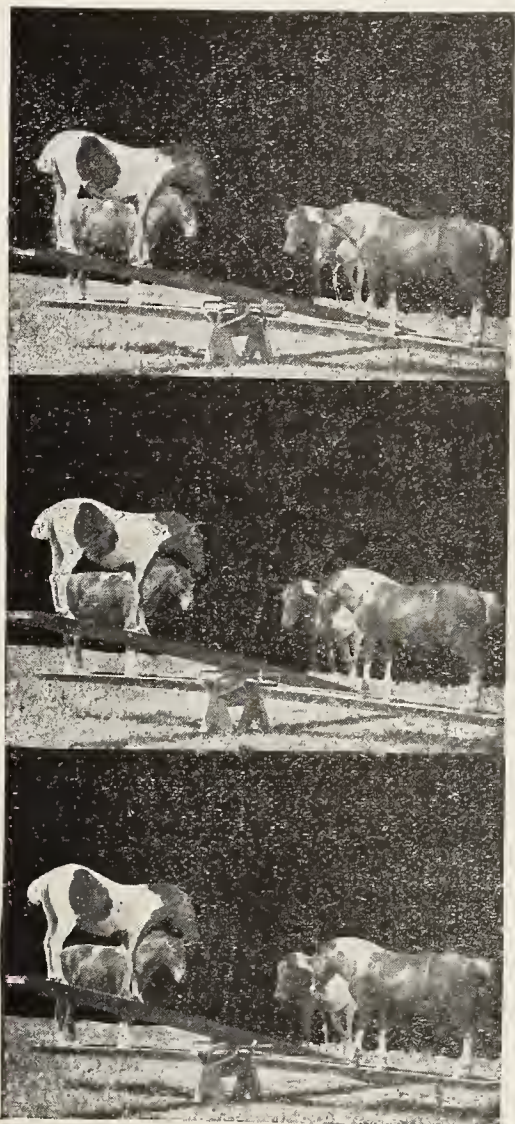


The Parlor Kinetoscope.

ment of sewing machine treadle.

They further state that this is not in any sense an experiment, but is thoroughly practicable, fully guaranteed and sold at a low price. In order to fill orders promptly it is necessary to advise them as to voltage and alternations of current, direction in which hand wheel of sewing

is a machine in which lifelike reproductions are made, comprising a long list of interesting scenes. The pictures pass before the eye at the rate of eight hundred a minute, and represent in perfect miniature with absolute fidelity to nature pictures that for animation and life cannot be excelled. The parlor kinetoscope is exceedingly



Films for Parlor Kinetoscope.

machine revolves, and style of plug for socket.

Hinton, W. Va.—The Hinton & Southeastern Telephone Company has been incorporated by A. J. Skaggs, James H. Miller, J. J. Swope, C. H. Skaggs, and W. H. Bonde. Capital stock, \$50,000.

West City, Ohio.—Citizens' Telephone Company has been incorporated by James H. Miller, Leland B.

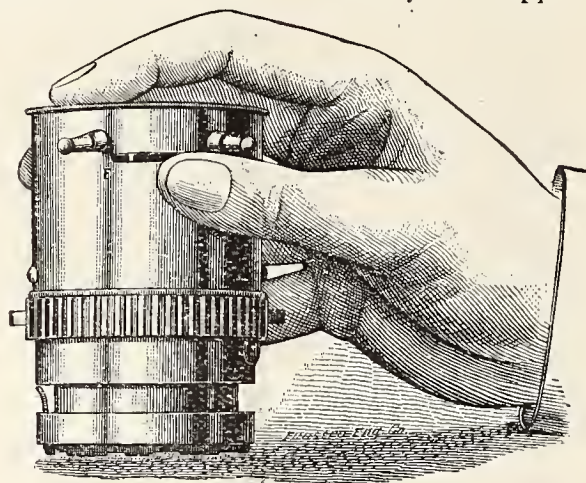
cheap, and as a Christmas present would be regarded as a source of unmitigated joy by its possessor. By bringing to the home such means of amusement the younger as well as the older generation may be made familiar with events, countries, historical and other scenes that will remain ever fresh in the mind. The Edison Phonograph Agency, F. M. Prescott, manager, with offices and

salesrooms in the Edison Building, 44 Broad street, New York City, have placed this exceedingly simple — upon the market with varieties of films sold at a very low figure to purchasers.

Time stamps have always been more or less a source of constant worryment to their possessors ever since their

as the mechanism is so constructed as to intercept any pressure.

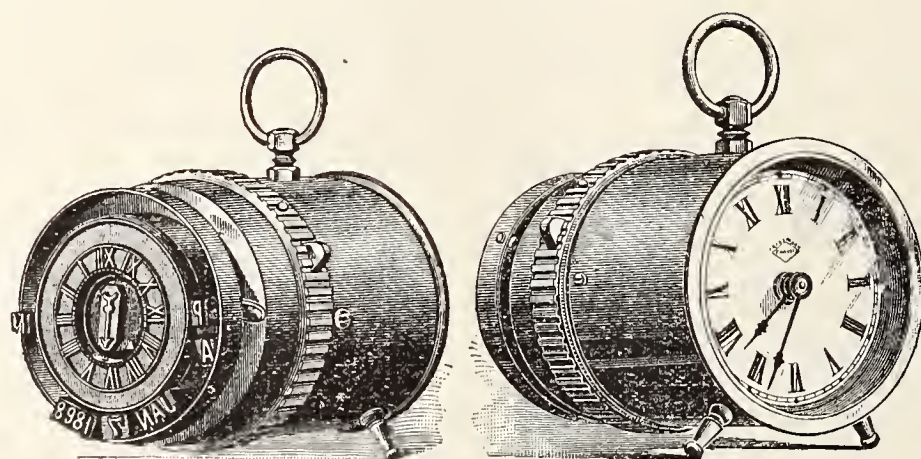
The Penny-in-the-Slot Gramophone is simple in construction, and consequently never becomes deranged; the sound it produces is clear and pure, and the range of subjects supplied with this machine cover a long and



Emerson Time Dating Stamp

invention, and any time stamp, therefore, combining the elements of simplicity and reliability is sure of a hearty welcome in all places where an instrument of this kind is needed. The Emerson time-dating stamp, sold by the Edison Phonograph Agency, and illustrations of which are shown herewith, possesses all the elements of cheapness, simplicity and utility, and will therefore supply a

interesting list of popular songs, up-to-date music and various instrumental selections, as well as recitations, etc. The "Daily Mail," of London, speaks of the close of this century and the beginning of the next as the slot age. If this is true, one of the leading representatives of that age may be found in the form of the penny-in-the-slot gramophone.



Front and Rear View of Emerson Time Dating Stamp.

long-felt want. As will be seen in the illustrations, the one end of the stamp represents an office clock, the other end being provided with a rubber dial and movable hands, with which the impressions are made. The hands on the printing end are connected with the clock centre in the same manner as the hands on the face of the clock and are therefore always in unison with the same. When an impression is made with the stamp, the time stamped

The Edison phonograph, whose fame has reached every civilized centre on the face of the globe, has been making rapid progress since its first sale on the market. Science has improved it to such a point of perfection that the timbre and volume of tone is a perfect facsimile of the original, whether recitation, a vocal or instrumental selection. The phonograph has become so popular that the merest tyro feels behind the age by not possessing



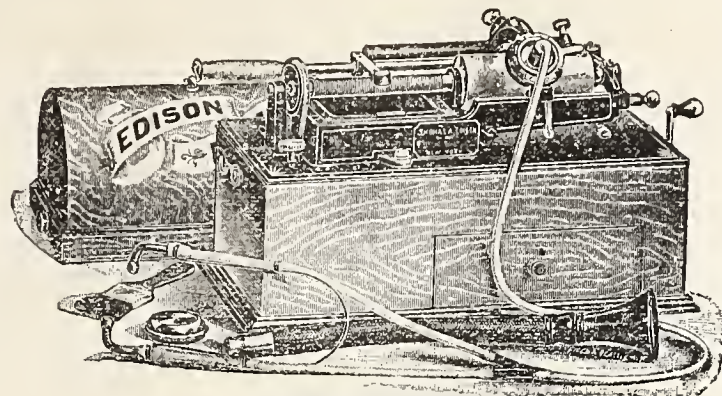
Penny in the Slot Gramophone.

is the same as that showing on the face of the clock. The stamp not only impresses the time, but also the day of the week, month and year. The clock is accurate and reliable, and will run forty hours with one winding; is not affected by the jarring caused by making an impression,

one. It is unnecessary to state how much interest and amusement pertains to the use of a talking machine, but the proof of its extreme popularity is evident when an attempt is made to get a friend owning one to exchange it or sell. People owning phonographs keep them because

many family records are taken—records of social gatherings and the voices of the dead, as well as the living, who, as it were, can speak from the grave, years after they have rested in Mother Earth. This modern miracle performed

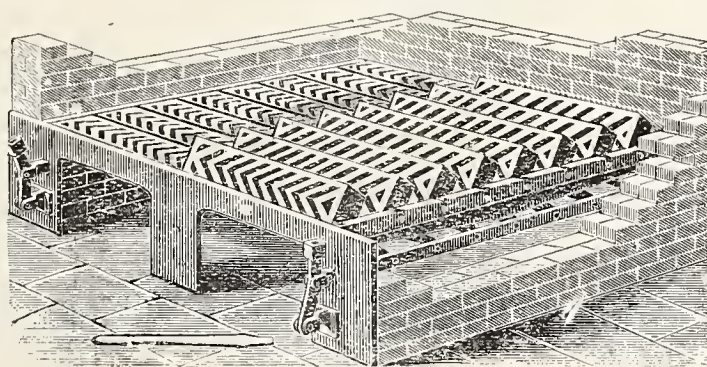
ly used for many years. More than eight thousand cases are on hand and can be furnished to the customer of places where W. W. Tupper & Company have successfully installed their patent grates. Many steamers, fac-



Edison Phonograph.

by the phonograph makes it ever dearer to its possessor, and is as hard to part with as the family portrait. Mr. F. M. Prescott, the agent, will be pleased to receive visitors calling in reference to the above articles.

tories and private plants fitted with these grates have been operating successfully for a period of over ten years. The grates do not warp or break. They are interchangeable and cheap. The largest as well as the smallest pea coal is equally useful for fuel with these grates.



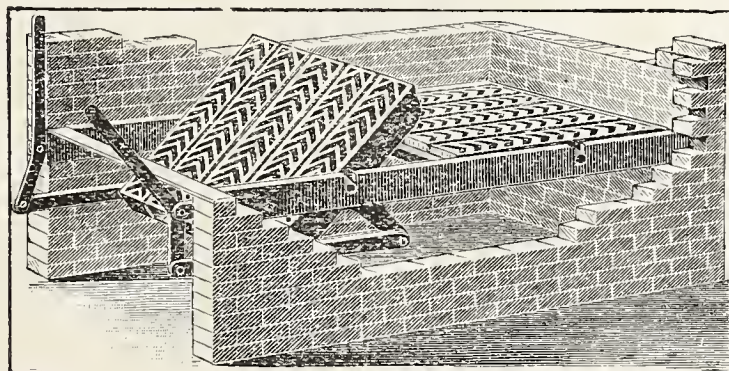
Rocking Grate.

ELECTRIC LIGHT AND POWER APPLIANCES.

SECTIONAL GRATE AND GRATE BARS.

W. W. Tupper & Co., manufacturers of the patent sectional grate and gratebars for steamers, locomotives

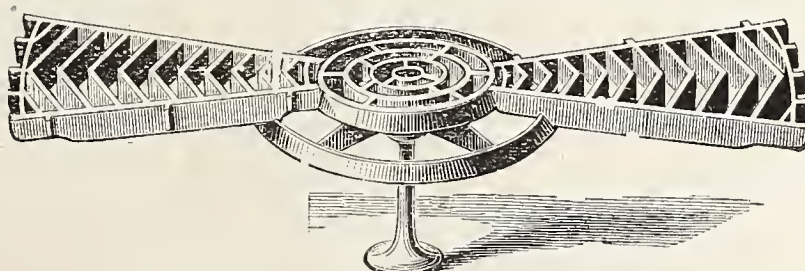
The rocking grate, dumping grate and grate bar for the now Corliss & Manning boilers, illustrated in these columns, save thousands of dollars per annum to coal consumers. The grate problem of economy has been solved by the use of sectional grate and grate bars manufactured by the above concern. The electric light and power concerns, including the New Brunswick Electric Light Company, of New Jersey, and the General Incan-



Dumping Grate.

and stationary boilers, as well as grate bars for anthracite and bituminous coal, sawdust and shavings, have their offices at 39-41 Cortlandt street, New York City.

descent Arc Light Company, of New York City, speak very highly of the sectional grate and grate bars installed in their boilers. Some few others having the same opinion



Grate for New Corliss & Manning Boilers.

They manufacture, in addition to the above, shaking and dumping grates, the great advantage of which is that they may be operated without opening the fire doors. The sectional grate and grate bars have been extensive-

are the United States Electric Light and Power Company, of New York, the Suburban Electric Light and Power Company, of Elizabeth, N. J., and the Lakewood Electric Light Company, of Lakewood, N. J.

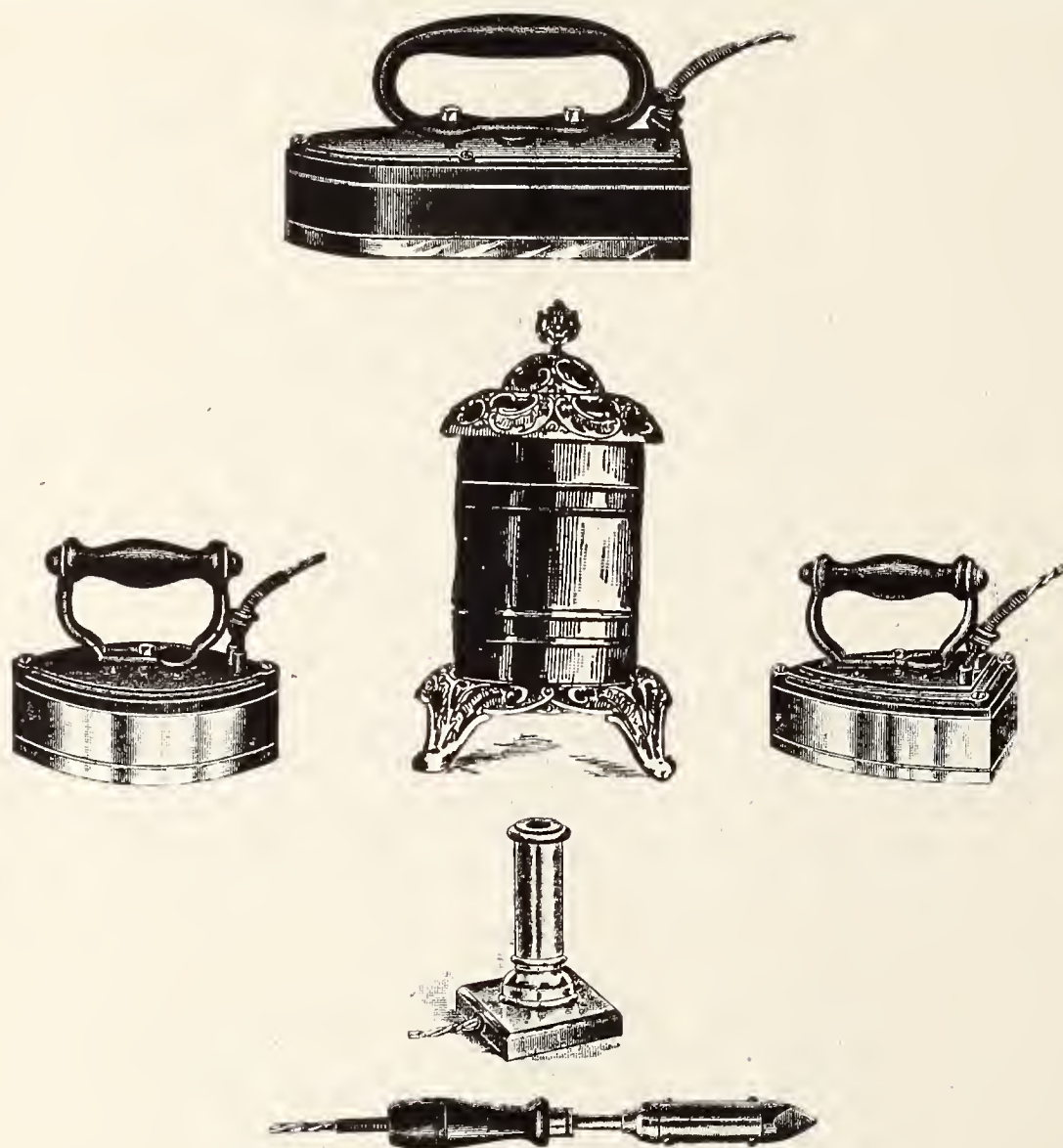
ELECTRIC HEATING.

ELECTRIC HEATING DEVICES.

Those living in the twentieth century will enjoy many luxuries, among which will be found electric heating devices. The price of electric power is becoming less and less each year, and with this reduction is found a corresponding increase in the number of electric heating devices for domestic purposes. Electric irons for laundry work, soldering irons for the tinsmith, heavy electric irons for the tailoring establishments, electric curling irons for hair-dressers, etc., as well as electric heaters, are to-day articles of wide use. It is hardly necessary to refer to the advantage and convenience of these utensils, and it is obvious to the observer that power is only used

the war interest was most intense, it drew large crowds of people. Electrical development is so fast nowadays and the newspapers have described so many of the newer and more wonderful inventions that an exceedingly interesting and successful show is looked for. The officers of the Electrical Exhibition Company are: C. O. Baker, Jr., president; H. L. Shippy, vice-president; Geo. F. Porter, secretary and treasurer; Marcus Nathan, general manager; H. H. Harrison, L. F. Requa, J. W. Godfrey and C. A. Lieb, directors.

At a meeting of the Board of Directors of The Electrical Exhibition Company, held Dec. 7, 1898, Mr. H. L. Shippy was elected a director and vice-president in place of Mr. F. W. Roebbling, who resigned.



Heating Devices, American Electric Heating Co.

when it is required. This in itself means a saving which cannot be effected by any other means at our command. To say that twenty years from date electric irons, stoves, and various other utensils will be in common use is not stretching a single point. It seems to be a foregone conclusion with those supplying electric power and those who manufacture electric heating devices. The American Electric Heater Company, of 197 River street, Detroit, Mich., have placed a line of these goods on the market. They are cheap, serviceable and will wear as long as the old-fashioned types, heated on the stove. To those interested circulars will be sent.

EXPOSITIONS.

THE 1899 ELECTRICAL SHOW.

Mr. C. O. Baker, Jr., president of the Electrical Exhibition Company, has signed a lease of Madison Square Garden for another electrical show, to be held during May, 1899, under the auspices of and in connection with the 22d convention of the National Electric Light Association. Although the last show occurred in May when

ELECTRIC LIGHTING.

HINTS FOR HOLIDAY LIGHTING FOR MERCHANTS.

The holiday season is upon us—the evening crowds upon the retail streets grow with each passing day, and more stores are open evenings. Now is the time when the merchant with brilliantly lighted show windows and artistically arranged displays has the advantage. It is interesting and instructive to note the difference in effect between windows lighted in the ordinary way with incandescent lights in full view, and those lighted by the Frink Store Window Reflector, where no lamps show, but where there is light in abundance. The comparison is unquestionably favorable to the Frink system, for exposed incandescents, by their greater brilliancy, distract the eye from the goods displayed, and often make it impossible to see the goods effectively. Oculists agree without exception that the source of light should be behind a person, or at his side, in order that an object may be seen with the least strain upon the eyes, and this car-

dinal principle is recognized in the Frink system. It consists of a hood-shaped reflector, running along the inside of the glass at the top of the window. Inside the reflector the incandescent lamps are placed. The shape of the reflector shields these lamps from outside view, and reflects all the light within the window. Coming thus from practically over the observer, the light falls full upon the objects before him, giving an effect obtainable by no other method of lighting. Full information concerning this reflector may be obtained by addressing I. P. Frink, 551 Pearl street, New York.

AMONG THE SOCIETIES.

NEW YORK ELECTRICAL SOCIETY.

The 192d meeting of the Society will be held at the College of the City of New York, Lexington avenue and 23d street, on Wednesday, Dec. 14th, at 8 p. m. Col. Eugene Griffin, Colonel of the First Regiment of U. S. Volunteer Engineers, and first vice-president of the General Electric Company, will give an address on "Ideas Underlying the Organization of the Volunteer Engineer Corps; the Work Accomplished by it in Porto Rico, and the Opportunities of Further Usefulness." Mr. W. D. Weaver, late Chief Engineer of U. S. S. "Glacier," editor of the American Electrician, and Mr. F. W. Roller, late Chief Engineer U. S. S. "Nashville," will also address the Society on "Electrical and Engineering Work in the Navy During the War." In this manner the relations of the engineering profession to both the Army and Navy will be clearly brought before the members of the Society, and it is believed that the occasion will prove one of much general interest and value. The meeting is open to ladies.

BUSINESS NEWS.

SPECIAL EXPORT COLUMN—TOTAL ELECTRICAL EXPORTS FOR WEEK ENDING DEC. 6TH, 1898, \$59,702.

New York, N. Y., Dec. 6, 1898.—The following exports of electrical material are from the port of New York for the week ending this date:

- Alexandria—6 cases electrical machinery, \$947.
- Argentine Republic—6 packages electrical material, \$481.
- British East Indies—11 cases electrical material, \$280.
- British Australia—23 packages electrical material, \$376.
- Brazil—101 packages electrical material, \$912.
- Berlin—3 cases electrical material, \$60.
- British Possessions in Africa—10 cases electrical material, \$280.
- Bremen—6 cases electrical material, \$500.
- British West Indies—3 packages electrical material, \$150; 1 package electrical material, \$12.
- British Guiana—27 packages electrical material, \$650.
- Cuba—9 packages electrical material, \$113.
- Central America—1 case electrical material, \$160.
- Ecuador—1 case electrical material, \$34.
- Florence—1 case electrical material, \$50.
- Glasgow—18 cases electrical material, \$1,438.
- Hamburg—72 cases electrical material, \$3,276; 12 cases electrical material, \$3,345; 1 case electros, \$25.
- Havre—68 cases electrical material, \$2,741.
- Helsingfors—8 cases electrical machinery, \$500.
- London—212 packages electrical material, \$7,124; 87 packages electrical machinery, \$12,310.
- Liverpool—8 packages electrical material, \$1,893.
- Leeds—11 cases electrical material, \$367.

- Mexico—40 packages electrical material, \$1,837.
- Milan—28 cases electrical material, \$11,400.
- Manchester—3 cases electrical material, \$110.
- Moscow—8 cases electrical material, \$428.
- Newfoundland—7 cases electrical material, \$125.
- Naples—5 cases electrical material, \$255.
- Oporto—36 cases electric motors, \$5,600.
- Preston—1 package electrical machinery, \$10.
- Stockholm—1 case electrical material, \$386.
- St. Petersburg—17 packages electrical material, \$623.
- Southampton—2 cases electrical material, \$17; 18 cases electrical machinery, \$343.
- United States of Colombia—4 cases electrical machinery, \$300; 2 packages electrical material, \$17.
- Venezuela—7 cases electrical material, \$227.

BUSINESS CHANGES.

Worthington, Ind.—Worthington Light and Power Company has increased its capital stock to \$9,500.

Philadelphia, Pa.—Technic Electrical Works, a corporation of the State of New Jersey, has made an assignment for the benefit of creditors to Richard L. Binder.

Jersey City, N. J.—The Crocker-Wheeler Electric Company, with a capital stock of \$200,000, has been licensed to do business in Illinois.

POSSIBLE INSTALLATIONS.

Henderson, Tex.—The Henderson Electric Light Company will construct an electric light plant.

Seattle, Wash.—The Seattle power plant will be in operation by Jan. 1. The power is to be furnished from Snoqualmie Falls.

STREET RAILWAY NEWS.

Pittsburg, Pa.—Steps are being taken to construct an electric railway between Cadiz, Ohio, and neighboring towns, the line to be 22 miles in length and to cost \$100,000.

NEW INCORPORATIONS.

East Chicago, Ill.—East Chicago Light and Power Company has been incorporated by George W. Wilson, H. N. Bailey and W. L. Pike. Capital stock, \$15,000.

Sheridan, Ind.—Sheridan Light and Power Company has been incorporated by Charles S. Knight, H. C. Knight and W. L. Polhamus. Capital stock, \$9,500.

Groton, Conn.—Groton Electric Company has been incorporated with a capital stock of \$2,000.

Louisville, Ky.—Carter-Hays Electric Company has been incorporated by L. D. Curtis, E. W. Hays, H. C. Hays; to manufacture, repair, buy and sell electrical appliances. Capital stock, \$5,000.

New York, N. Y.—Delaware Electric Light and Power Company has been incorporated by P. G. Stappens, D. McM. Niven, and C. W. Phillips. Capital stock, \$250,000.

Clarendon, Ark.—The Clarendon Light and Heat Company has been incorporated, with J. W. B. Robinson, president; H. B. Bateman, vice-president; J. T. Jones, secretary and treasurer. Capital stock, \$6,000.

Rockford, Ohio.—Rockford Electric Lighting Company has been incorporated by C. S. Mauk, A. G. Stewart, D. C. Kuder, F. M. Kirby, J. D. Wagers, and W. T. Palmer. Capital stock, \$6,000.

Newark, N. J.—The Standard Automatic Lighting Company has been incorporated by Edmund K. Sargeant, Jr., Joseph Shetch, and R. Ten Broeck Stout. Capital stock, \$100,000.

Norwich, Conn.—The Russell-Tomlinson Electric Company has been incorporated, with a capital stock of \$20,000.

New York, N. Y.—Paragon Fan and Motor Company has been incorporated by William E. Smith, Richard J. Scoles and Samuel Thorn. Capital stock, \$15,000. Principal office, Washington.

TELEPHONE CALLS.

Smithfield, Tex.—The Isle of Wight Telephone and Telegraph Company has been incorporated by J. W. Thomas, J. W. Holloway, W. D. Folk, L. C. Brock, C. S. Betts, J. C. Goodrich, W. J. Edwards, J. U. Burgess and W. N. McAuge; to do a general telephone and telegraph business. Capital stock, \$5,000.

Massies Mills, Va.—The Massies Mills Telephone Company has been incorporated by W. D. Meeks, James Dickie, J. C. Bentz, M. B. Hughes and others; to do a telephone and telegraph business. Capital stock, \$2,000.

St. Peter, Minn.—St. Peter Telephone Company has been incorporated by H. P. Proctor, Augustus Proctor, Frank A. Chase, J. H. Chase and Walter S. Proctor; to construct and operate a telephone exchange and telephone lines at St. Peter. Capital stock, \$10,000.

New Haven, Conn.—The Southern New England Telephone Company has mortgaged its property to the New Haven Trust Company, for \$1,000,000.

NEW YORK ITEMS

Mr. F. B. CROCKER, of the Crocker-Wheeler Electric Co., 39-41 Cortlandt street, has left San Francisco on a business trip around the world.

THE NEW JERSEY VALVE CO., 120 Liberty street, solicit correspondence regarding their "Security Fog Signal," a new form of electrically controlled whistle valve. A description of this valve will appear in an early issue of the "Age."

Mr. MARTIN J. INSULL, the well-known electrical engineer of Chicago, will be in town this week on business.

C. H. KIRKLAND, 129 Greenwich street, has been appointed New York manager for the Bibber-White Company, of Boston, manufacturers and dealers in insulated wire, electric light and power supplies, etc.

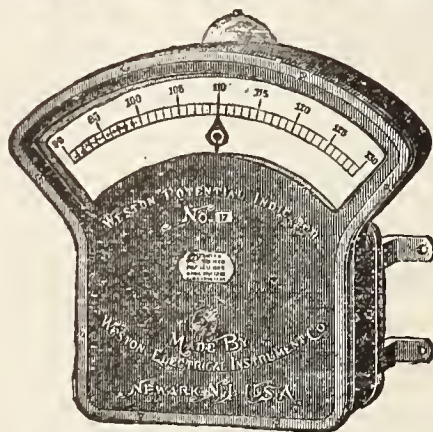
S. P. DENISON, electrical expert and model-maker, and well known as the inventor of writing telegraph apparatus, is gradually recovering the use of his right side, which was paralyzed through a bicycle accident over a year ago. Mr. Denison's office and works are located at 143 Centre street.

ARTHUR WARREN, the advertising manager of the Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa., is in town.

W. S. BARSTOW, the well-known general superintendent of the Edison Electric Illuminating Co., of Brooklyn, has been appointed general manager of the Kings County Electric Light and Power Co.

THE NORTHERN ENGINEERING COMPANY, of 39-41 Cortlandt street, is composed of Messrs. George C. Hoffman and Theodore W. Kloman, two electrical engineers of considerable note and prestige. These two gentlemen have been associated with some of the largest electrical engineering and contracting firms in the country and have been very successful in installing large isolated plants for electric light and power. Through their energy and hustle for business they have made themselves very popular, and on this account they were singled out by the Northern Electrical Manufacturing Co., of Madison, Wis., and appointed their Eastern managers. They have added to their stock of electric power specialties by becoming the licensees of the Electrical Appliance Company, 27 Thames street, makers of the well-known gravity motor controllers for elevators, pumps, etc. The Northern Engineering Co. will manufacture and sell these controllers in the United States and Canada. Mr. G. A. Nesbit, the former manager of the Electrical Appliance Co., introduced and popularized the gravity motor controller, and Messrs. Hoffman and Kloman, through their knowledge of the business, will undoubtedly place this specialty in its proper sphere. They are placing some excellent contracts, and have already sent a number of large orders for dynamos and generators to the home office, surely a good showing for a firm only a few months old. The Northern Engineering Company are also the Eastern agents for the Warren-Mcderby Co., the manufacturers of the inductor type of alternating dynamos.

WESTON STANDARD ILLUMINATED DIAL STATION INSTRUMENTS.



THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

75c.

"VULCAN" STYLOGRAPHIC PEN.

75c.



"INDEPENDENT" FOUNTAIN PEN.



PRICE, WITH ENGRAVED HOLDER, \$2.00. SAME WITH GOLD BANDS, \$2.50.

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AGENTS WANTED.

J. K. ULLRICH & CO., 27 Thames St., New York.

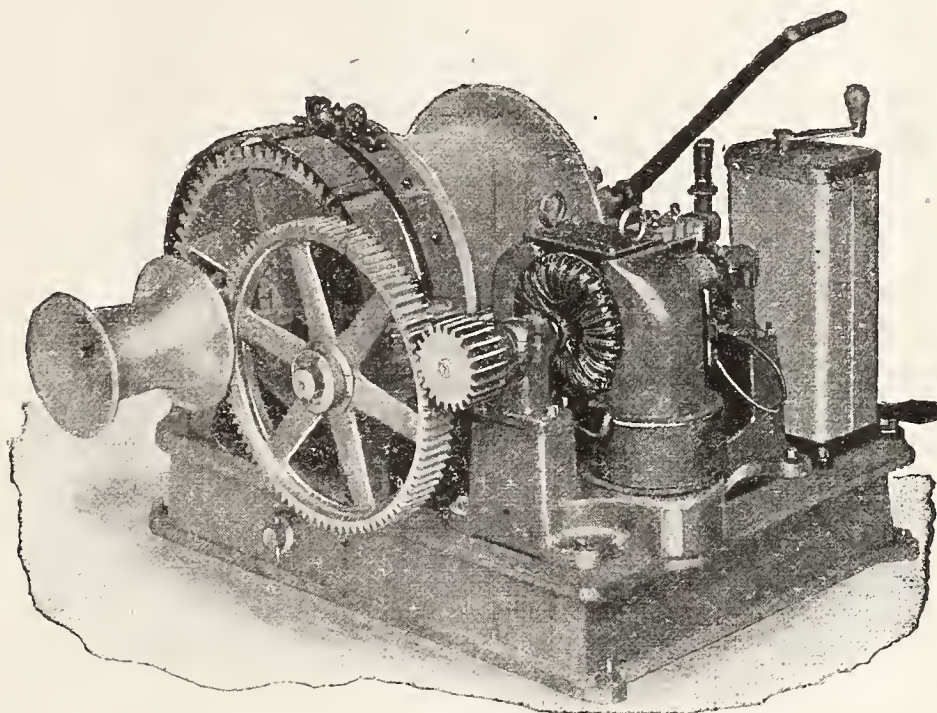
The Electrical Age.

VOL. XXII—No. 25

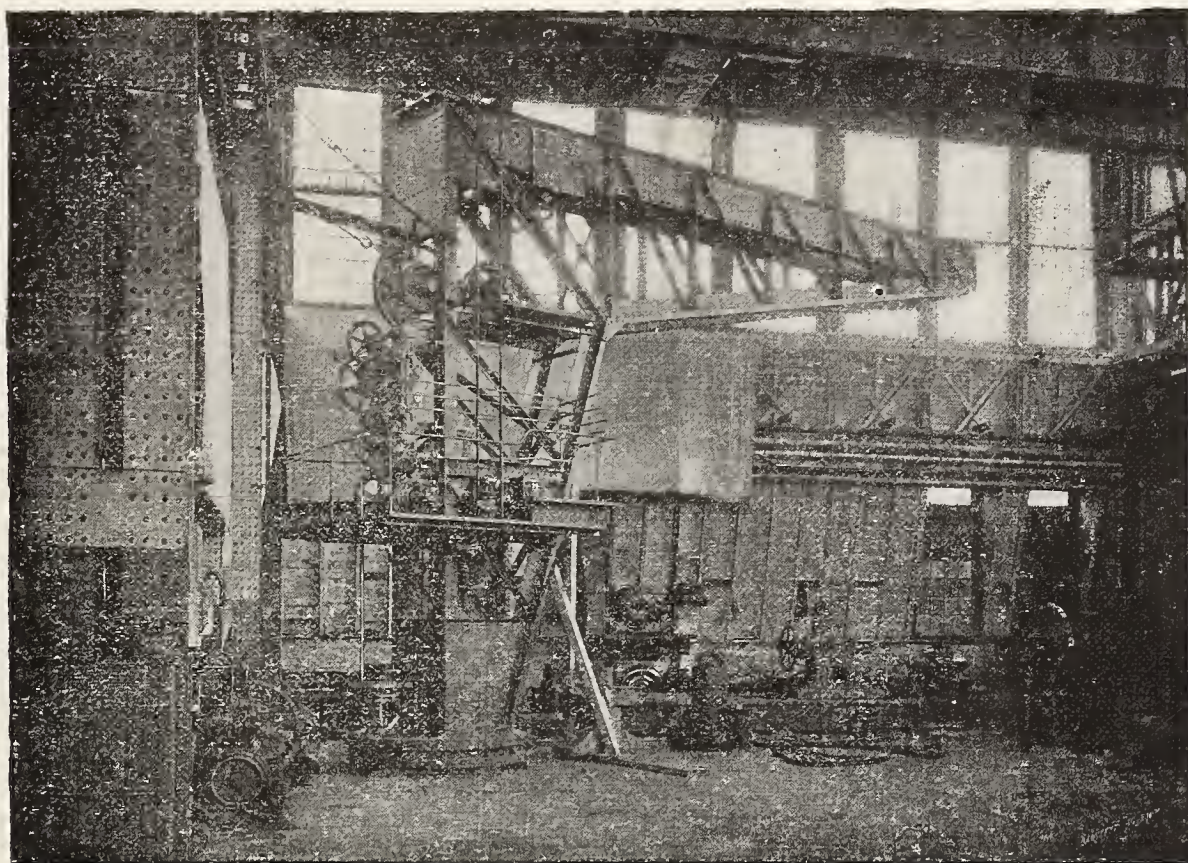
NEW YORK, DECEMBER 17, 1898

WHOLE No. 605

ELECTRIC LIGHT AND POWER.



C.-W. Motor Geared to Contractors' or Portable Hoist.



C.-W. Motor Geared to 15-ton Sellers Jib Crane, Cambria Iron Co.

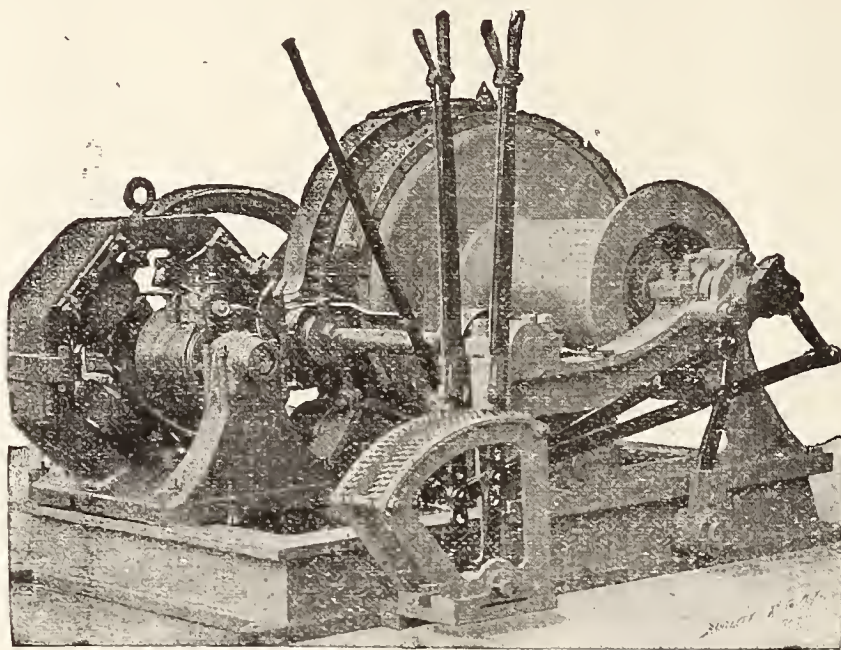
ELECTRIC PUMPS AND HOISTING MACHINERY.

The progress of modern engineering has been stamped with certain characteristics which relate mostly to a saving in time and rapidity in execution. A machine may operate quickly but before it is ready to accomplish a given amount of work more time may be spent than by the old-fashioned methods of procedure. The art of engineering therefore calls largely upon the time element, other things being equal. Modern mining has rapidly assumed a position in the field of industrial activity so as to

apply to itself all that is true in other fields of engineering. Pumping and hoisting are not necessarily integral parts of mining practise. Such machines are required for so great a variety of purposes that it would be difficult to limit its scope of usefulness to one particular field. Since the advent of the motor and the establishment of its success and proof of its ability to compete in the open market with other power producing devices its application to innumerable machines, such as pumps, hoists, etc., has

become an accomplished fact. The tide of change flows in slowly but it effectually drowns old-fashioned and expensive methods. Electric hoists and pumps and even great cranes, such as shown in the illustration, in mining

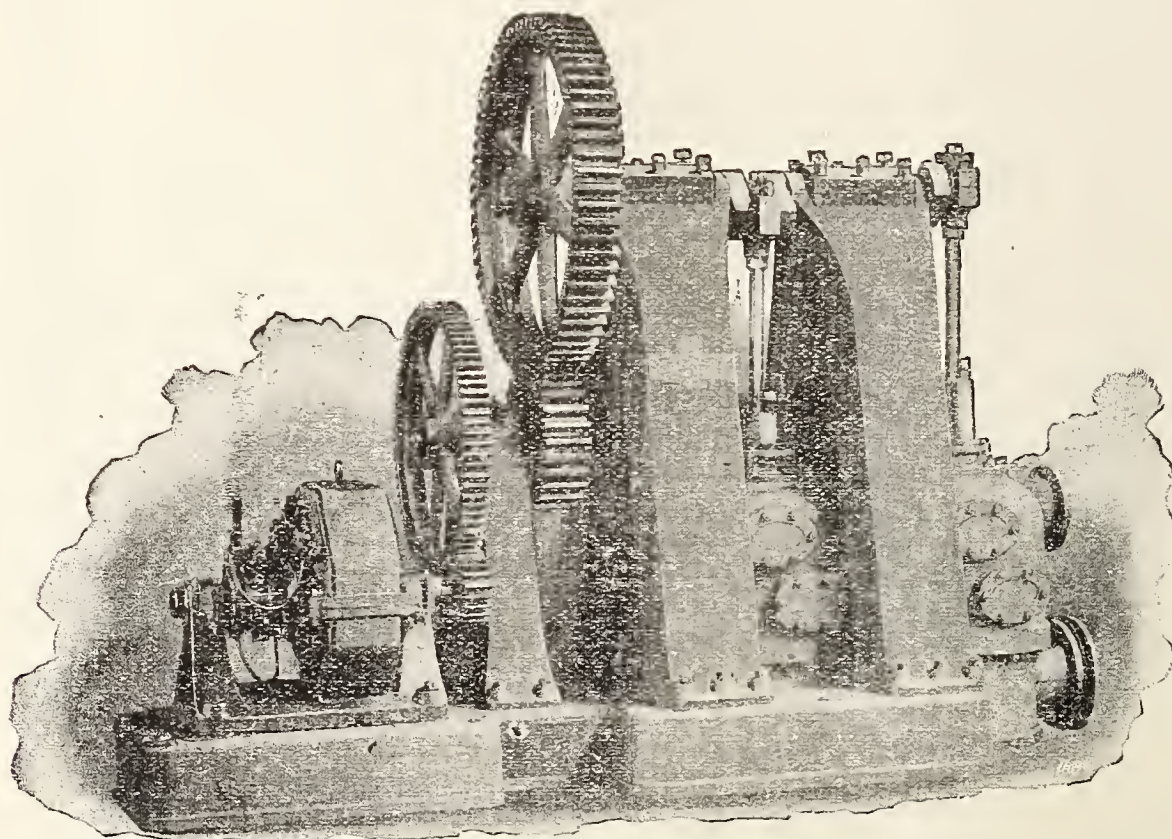
this system of connection the natural speed of the motor does not call for special low speed machinery, which is generally larger, heavier and more expensive than in this case, i. e., a fairly high speed motor geared and doubly



C. W. Motor, Geared to Two-Speed Skull Cracker Hoists.

and manufacturing are successfully driving out their steam-driven predecessors. The Crocker-Wheeler Electric Company manufacture complete outfits for general mining and foundry work. The design of the motors and

reduced operating the pump. Power transmitted this way obviates many of the most disagreeable features of construction. It reduces the waste of power and really increases the capacity of the machine without affecting



C. W. Motor Geared to Worthington "Steeple" Pump.

their connection, as shown with the machines they operate, is of such a character that a minimum of power is lost through friction. The electric pumps, of course, are simply motors geared to pumps of high-class make. By

other important factors. Uniform speed naturally results and a steady and powerful stream of water may be kept flowing for hours and even days at a time. The electric hoists and cranes belong to the same class of machinery.

There is a moment at which the strain upon the motor is exceedingly great, and in consequence of this their design is of such a nature that a temporary overload causes absolutely no injury. A great mass that is swung into the air from a condition of rest does not really call for an instantaneous effort on the part of the motor, because time is consumed in leaving the ground as well as reaching it. The proposition is therefore not a difficult one. The motors applied to these hoists will lift a given weight at a given speed per minute or a greater weight at a proportionally lower speed. Inured against moisture, durable in construction and highly efficient in their consumption of power these combinations have gained greater and greater popularity, sufficient, in fact, to make their general use in shops, mines and factories an absolute certainty.

COMMUNICATIONS.

ADEQUATE FIRE PROTECTION FOR HIGH BUILDINGS.

A fire lately occurred on Broadway involving an old-style low building and a modern fireproof skyscraper. The Fire Department sent rattling along its antiquated paraphernalia, but on account of a high wind, it was unable to control the fire in the low building; and because some inspectors were delinquent in their duties in not having the skyscraper provided with fireproof window shutters, the latter caught and burned out the interior of its upper stories. The Fire Chief did the best he could with his liliputian apparatus. His little steam squirt guns, on wheels, puffed and snorted; his Siamese pipe-stem of a perambulating water tower could not be lengthened seventeen stories high, and so he called more funny little squirters and towers to his aid. But all the Chief's horses and all the Chief's men could not effectively squirt higher than nine stories. The Chief saw the ridiculousness of his primitive efforts, for he is quoted as saying: "Let her burn, boys!" An extended conflagration might have ensued as far as the Department was concerned had not the fireproof structure stood like a mighty bulwark and fire-wall to protect what was beyond.

Old-method "authorities" now tell us a law should be passed prohibiting buildings from being over a certain limited height in New York—all because the Fire Department's apparatus has not kept step with the changed modern building construction. A little later some other "authorities" from sleepy Philadelphia—where grass is supposed to grow in the streets—came to view the ruins, and they also evoked a new law limiting building heights, and imply as well that modern progress must be jerked back to the limits of their old claptrap fire-fighting apparatus. They do not even concede that fire-extinguishing methods can be made to conform to the changed building construction.

The whole thing is a farce, worthy of being treated by a Cervantes or a Dean Swift.

It took Chicago to build a World's Fair that surpassed the best European effort. Our city's best effort in this line has been the old Institute Fair "food exhibits" at the Grand Central Palace, Madison Square Horse Show, and Barnum's circus.

San Francisco and Kansas City had cable street railways about the same time that our Broadway had a horse-car line, and even this line was fought so hard by the Hebrews along the route, who frothed at the mouth and frantically gesticulated their wrath, and called on Moses to witness the sacrilege, that the city crucified poor Jake Sharp for employing the only means—bribery—to give the city this great benefit.

It is hard for a man to be progressive and honest and succeed in this city.

Chicago has used electric traction on her elevated roads several years, and we are still enduring the dis-

comforts of sulphurous fumes, cinders, ashes and dripping hot water.

We were copying the Prince of Wales' clothes and London stage coach locomotion long after Western cities had electric traction.

Chicago, Milwaukee and little Akron, Ohio, had their electric wires underground long before we conceived the practicability here. The same with the improved fire and police telegraph methods; and it is the same with nearly everything else.

We are the true mossbacks, and have much to learn in fire-fighting methods from the energetic, wideawake, wild and woolly West. Even the supple, strong convenient, economic, safe, fire-proof, modern, steel-frame skyscraper we copied from Chicago. Our architects and capitalists were pessimistic on the subject long after their worth was proved in the West.

All experienced traveling men know that a fast express train is safer than traveling on an accommodation or a freight train, and for much the same reason a skyscraper is safer on account of the great skill and the best of material used in construction.

Whoever heard of the necessity of shoring up one of these buildings to keep it from tumbling down, like the low, flat Rothschild building in Brooklyn?

Instead of laws limiting the height of building, called for by the New York and Philadelphia fire chiefs, we should require laws compelling the building of nothing but skyscrapers along the blocks facing Broadway, in the place of the low buildings that are the true sources of conflagration.

Whoever heard of a serious fire originating in a skyscraper?

Two parallel blocks of rows of skyscrapers from the Battery to the Harlem River would prove an efficient fire-wall, extending along the backbone of Manhattan Island, to prevent an extended conflagration in a high wind, such as devastated Chicago before they were built in that city.

The more twenty-five and forty-story buildings, the better; blow up the old rathole firetraps that disgrace our main thoroughfare, and allow us to become a representative modern city.

If our burnished toys of perambulating steam squirt-guns with their water towers cannot squirt higher than nine stories, they are evidently of little use under changed modern conditions. Relegate them to Goat Town, or keep them for holiday parades, when the old volunteers drag their little hand-pumps along in memory of ancient times.

The next step will be as drastic as it is important—sweep out the whole official personnel of the present Fire Department, commissioners included; for it is not worth the pains to teach old dogs new tricks, and it is as impossible to reform confirmed old mossbacks as it is to rejuvenate old maids.

Then send West for energetic, up-to-date, resourceful young men who have ozone in their blood—the same breed that made the World's Fair a success, and empty-handed built up her commerce and her industrial successes, and who are all devotees of the Western Goddess, "I Will," to replace the old "Has Beens" who want the world to stand still because they can no longer keep up with modern progress.

Then get some more of the same ilk from the same place—for we cannot find them here—who will inspect buildings during their construction, and not after they have fallen down or burned up; for we have too many Buddensiecks and Rothschild structures. Open boasts have been made by contractors that any of the present building laws can be, and have been, violated for a consideration.

The next problem to be solved is to make each skyscraper its own stationary water tower for its individual

purposes, and also to drown out fires in surrounding buildings, even those across the street, and to water-soak any insignificant tinderbox structure that may be on fire below.

Then construct permanent stationary means to conduct plenty of water to each building, independent of the present over-taxed water system, and then to provide means to get the water to the place needed with sufficient force.

To Western people the solution of these problems would be simple, easy and quick of practical solution. But to the old foggy mossbacks and time-servers in charge of our Eastern municipal departments, I doubt the possibility of the change unless we place the ideas on their heads and drive them clear through their cobwebby intellects with an axe; for their only originality consists in pulling down the buildings that are the pride of our city, in order to bring their roofs within the reach of their grovelling intellects and their little puffy old steam squirt-guns.

The tall buildings of Western cities are provided with two or more stand-pipes reaching through to their roofs, to which two or more engines may be attached to each pipe when necessary, and the water pumped in solid, unbroken streams, unaffected by prevailing winds, to any desired heights; and in certain sections of these cities hose carts do not accompany an engine.

Other cities, like Detroit, have laid underground conduits from the river, independent of the usual water supply system, and a powerful fire-boat forces the water to the desired locality, and may be operated, if desired, in conjunction with the stationary stand-pipe, with or without the assistance of the usual fire engine.

Few of our buildings are provided with accessible stand-pipes, and we are unable to avail ourselves of the admirable river fire-boats for inland purposes. Our only auxiliary to the toy fire engines is a water tank on the roof that seldom, if ever, is full, or holds enough water, or gives adequate pressure where and when most needed; or a pumping apparatus in the basement, that is of little use on account of the time to get it in operation, or is of sufficient capacity. Both of these aids, practice has shown, are quite impracticable and unreliable.

There is probably no city in the world so admirably situated as New York for adequate fire service to meet modern requirements. For, situated on a long, narrow island, completely surrounded by water—and salt water at that—we have ideal conditions for an ideal installation. We may even banish hose carts, water towers, and engines on wheels, and stop killing our citizens and the firemen (who are often strapped to their seats) in their mad career through our streets; sell our engine houses and take our firemen to fires in comfortable patrol wagons unaccompanied by the deadly juggernauts of dangerous fire apparatus.

This may be done by building underground parallel pipe lines at convenient distances apart from both the East and North rivers toward Broadway, with suitably situated and accessible valves to prevent undesired inter-communication.

These pipe lines could be connected to commodious stand-pipes in each building, and each floor provided with hose, and each fourth floor provided with pipes branching toward the exposed sides of each building from the stand-pipe, and provided with a dirigible nozzle toward the streets and areaways.

The river ends of each pipe would be provided with from three to five Siamese connections, to which the same number of fire boats could be connected. It will then be possible to generate a water pressure that will blow the very skylights out of a fifty-story building; and if five fire boats cannot do it, connect the stand-pipe with five other fire boats from the other river.

A fire on any floor of a building thus protected may be fought from within by half a dozen streams of salt

water, and from without with as many more from adjoining buildings, especially from across the street; and if any tiny steam fire engine wheezes its protests, it could, by these means, be washed into the bay.

If it be economical to build skyscrapers, it will pay to protect them.

This system may find other very economical uses—such as flushing the sewers, sprinkling and sweeping the streets, melting snow and quelling riots.

The construction of a complete system of fire protection for Manhattan Island, substantially of the character described, would give us facilities far ahead of anything in the world. Then why wait for Oshkosh or Kalamazoo to set examples for us to follow like imitative monkeys, or adopt some little wrinkle from a jay town out West, when nature has given us advantages enabling us to be leaders and grandly systematic and progressive? As a city we should be admired and imitated for our progressiveness, instead of ridiculed for our conservative, servile imitations and antiquated, ineffective fire system.

The upper part of the Island being much wider than the lower part, and the centre being farther from the river on each side, we might require an auxiliary system, in case sixty-story buildings should be built in Harlem. When that time arrives, we will be duly prepared to master the situation by installing at convenient distances throughout the buildings, compact, efficient, direct-connected electric rotary pumps, taking their power from those unfailing sources of supply—the electric light and electric railway circuits, or both conjointly to insure positive results. This auxiliary system would help out our parallel pipe system, as outlined above, and compensate for the water friction in the additional length of pipe lines, and the added heights of the stand-pipes, and in case of accidents of any nature, these electric pumps could be connected with the present water system.

Our present water system is, from recent examples, too glaringly inadequate and out of date; and even though my suggestions are adopted finally by the city, it will take our municipal fathers and heads of departments so long to get their commissions agreeably adjusted, that I would seriously advise the owners of our skyscrapers to place no further reliance on the senile Fire Department, or await the tardy action of the commissioners in the matter; but take immediate steps to instal the electric pump system, as outlined for emergency purposes, and thus be independent of municipal incapacity and procrastination. The chief points in its favor are its quickness, facility and cheapness of the installation and operation. It requires no skilled attendance, other than the intelligence of turning a switch lever or a rheostat handle, and requires no addition to the present building employees. No steam boilers or additional machinery will be required. In fact, the system will be independent in all respects from existing apparatus, with practically no expense after installation, except interest on cost price, and for electric current in case of fire, and possibly no appreciable extra piping, as the pumps could be connected directly to the existing water supply pipes.

This will be the most efficient makeshift possible until a dozen more million-dollar fires thoroughly accentuate the utter worthlessness of our fire system, and a long-suffering public get thoroughly aroused and demand radical improvements.

Cheraw, S. C.—The New England Electrical Company has been incorporated by W. E. Price, E. A. Palmer, G. T. Nicholls and W. P. Pollock to engage in a general manufacturing business, electricity not being mentioned. Capital stock \$250,000.

East Orange, N. J.—Standard Automatic Lighting Company, incorporated by Edmund K. Sargeant, Jr., and others, to erect light plants. Capital stock \$100,000.

The Electrical Age.

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FIRE PROOF SKY-SCRAPERS.

The punishment of Prometheus for stealing fire from heaven was the perpetual agony of having his liver devoured by an eagle. If it were not for this the necessity for fire proof buildings would never have existed. The sufferings of Prometheus cannot be one iota to those of a large fire insurance corporation that insures a so-called fire proof building and then discovers too late that they had dealt with a delusion. In a recent editorial the subject of fire was considered from quite a different standpoint. Fire protection engineering, as it may be called for want of a better name, takes into consideration the possibilities of fire, not only through an external cause, but due to a conflagration resulting from the dangerous proximity of steam pipes, gas pipes, electric light wires, electric light machinery, etc., to things combustible. The general arrangement of the necessary appliances of a modern office building, or in fact of any other building, should be such that the risks of fire determined by a scientific method of investigation are reduced to an absolute minimum. The habit of putting up tall buildings has grown upon the people of our most progressive American city. They are generally better buildings and certainly more comfortable and in general safer than those of an older type, but the chances of their becoming a gigantic blazing torch, as per the case of the Home Life Insurance Building, are certainly increasing, and unless means are taken to prevent the re-occurrence of such an

accident, hundreds of lives will pay the penalty of this neglect. It is true that like the polyps of the Southern seas we rise by building upon the bodies of the dead, and all modern progress has been due largely to such sacrifices. Yet are they necessary? It seems not unless we lose confidence in the efficacy of our fire alarm corps and their appliances. It is very likely, and, in fact, extremely probable, that the damage done to the Home Life Building would have been avoided by the use of iron shutters on the windows, automatically controlled by electricity, so that at the mere suggestion of a rising temperature outside they would fold tight. Another suggestion is that certain iron posts be provided with electrical connections for the purpose of forcing up to any height a stream of water ejected from a powerful electric pump, perfectly portable, supplied with the proper length of hose and owned by each large office building in the city. Whereas it is the evident intention of proprietors of large office buildings to have them constructed so as to be immuned from fire, still great dependence is placed upon the city fire engine corps. The buildings themselves ought to be provided with appliances for putting out a fire, and a weekly or monthly examination made by a responsible city board to see that such devices are always in good working order. It seems certain that the inspection of elevators is not more important than that of the building itself, not to discover whether it is safe from fire risks, but to see that it is provided with means for quenching the flame instantly wherever it may arise. Electrical inventors can take the hint at once.

TRANSATLANTIC TELEPHONY.

This question periodically arises and seems to bring with it an influence of so fascinating a character that however often the problem may arise there will always be some ready to solve it. The lay mind regards this colossal project as one of an extremely simple character, the reasoning being, "If we can talk across the continent, why can't we speak across the ocean." It is hardly necessary to rehash the technical reasons why transatlantic telephony is at present impossible, but we can say with a certain degree of confidence that is not based upon faith that its accomplishment will not be deemed an impossibility until proven so. The unfortunate effect of electro static capacity in a cable and the difficulty of neutralizing it makes many scientific men feel that the problem is beyond them. If a system of automatic telephone repeaters were installed tightly cased at the ocean's bottom every hundred miles or so it is very likely that speech might be attempted. But this is grasping the bull by the horns, accepting the difficulties and not seeking to remove them. It is certainly more scientific and satisfactory to attempt to remove electro static capacity by building a cable coiled as it were for the purpose of giving it a uniformly distributed self induction which might remove much of its capacity. The idea of Edison to establish a line of repeating stations anchored permanently is extremely practical as compared with other suggestions, but unless the art of transmitting speech is absolutely changed by the development of a new system transatlantic telephony is an alluring ignis fatuus.

Brazil, Ind.—Electric Haulage and Manufacturing Company has been incorporated by James H. McClelland, Edmund C. Morgan and Charles B. Nibloch to manufacture motors and machinery. Capital stock \$10,000.

Williamsport, Ind.—Williamsport Water and Light Company has been incorporated by John H. Brown, B. O. Mayer and George Mayer to operate a water system and furnish electric light. Capital stock \$10,000.

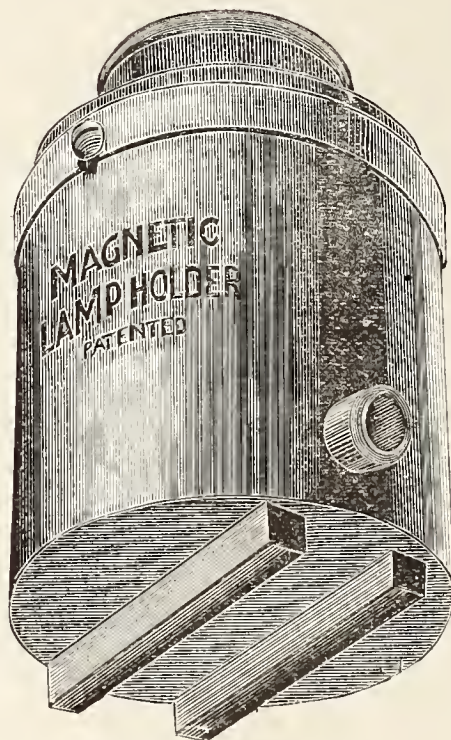
Bradford, Ill.—Bradford Electric Light Company, incorporated by Robert Thompson and others; electric light, heat and power. Capital stock \$10,000.

ELECTRIC LIGHT AND POWER APPLIANCES.

THE MAGNETIC LAMPHOLDER.

One of the most unique and absolutely novel devices on the market is being manufactured and sold by Jenkins

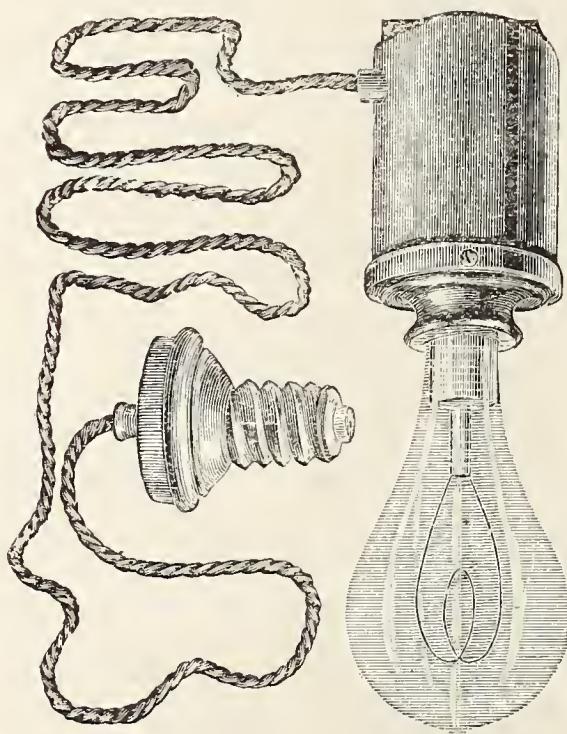
such as drill press, planer, lathe, etc., either at the head stock, tail stock or any part of any other machine in any position desired. In boiler shops, railroad shops, in mines, basements, cellars, bank vaults, in fact, wherever there is a square inch of iron to stick it on, this lamp will find a resting-place, hang tight, and give all the light just where it is wanted. One direction must be observed is to never turn off the current before holding the magnetic



Jenkins' Magnetic Lampholder.

Brothers, 71 John street, New York. It consists of a socket for an incandescent lamp containing an electro-magnet through which the current circulates and thereby

socket in your hand. Whoever invented the magnetic lampholder had an eye to business that was particularly keen. This holder will certainly meet with universal use



Jenkins' Magnetic Lampholder, with Lamp Attached.

magnetizes the lampholder sufficiently to make it adhere to any piece of iron or steel work. The magnetic lampholder, as it is called, will hang on to a machine tool,

and its inventor will be silently blessed by thousands of machinists who sometimes do poor work for lack of good light.

GENERATORS.

THE WING ACETYLENE GAS GENERATOR.

With the introduction of acetylene gas as an illuminant for general use, there arose a demand for a suitable generator for the same; a generator which would combine the elements of compactness, simplicity and safety. By combining these factors a generator would result which could be operated by the ordinary mortal without the fear of being spread sectionally to the four winds, this form of demise being the popular conception of the fate of any person rash enough to experiment with the sun's latest rival for illuminating honors.

The Wing acetylene gas generator has been designed for general use and combines in itself all the elements necessary in an efficient and safe generator. Among a few of its most noteworthy features are the following:

7. The pressure is constant and can be set at any pressure desired.

8. The workmanship is of the very best and every generator is guaranteed against any imperfect work or material for one year.

The following interesting table shows the relative cost of acetylene gas, electricity, ordinary gas, argand gas burners and incandescent gas burners, the comparison being based on an equal number of candle power for each kind of light. The prices for gas and current are those prevailing in this city.

Light.	Cost, per 1,000 ft.	C. P. hours.	C. P. hours for \$1.00.	Cost of 1,000 C. P. hours.	Equal to city gas 1,000 ft. at	Saving, favor of acetylene gas.
City gas,* cu. ft..	\$1.25	3,200	2,500	\$0.39	\$1.25	60%
Electricity, Watts	.25	400	1,600	.62	2.00	70%
Acetylene,* cu. ft.	7.50	50,000	6,700	.15	.48	..

*Open flame.

As will be seen by the above table the figures are very much in favor of acetylene, which as an illuminant is the



Wing Acetylene Gas Generator.

1. The generator is self-contained, there being no outside carbide holders, water tanks, coolers or complicated systems of valves.

2. Small space occupied for number of lights supplied.

3. The carbide holders are small and easily charged or emptied.

4. The carbide holders are closed with screw and gasket, similar to steam joints, and are therefore absolutely gas tight.

5. The gas is cooled and purified as rapidly as made and therefore is dry and free from all impurities when it reaches the burners.

6. There are only two valves to handle and the carbide holders can be emptied and filled without disturbing the lights or admitting any air.

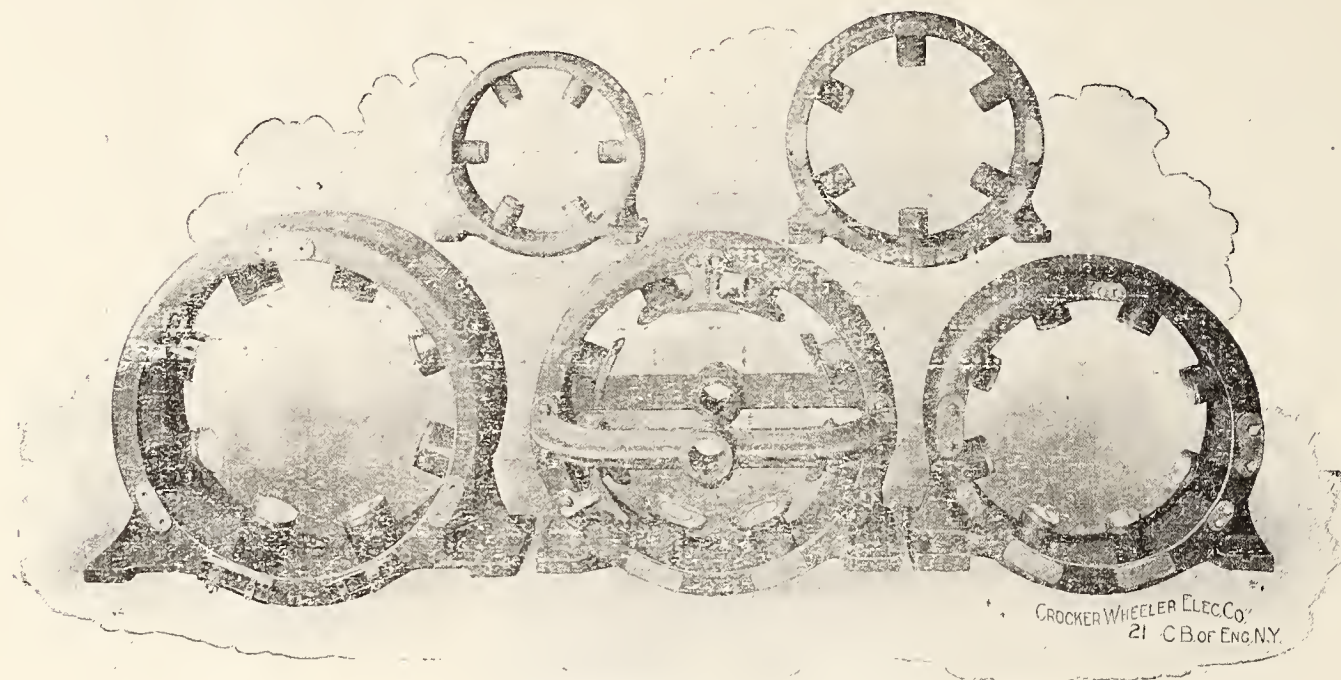
most perfect artificial light known, rivaling the sun itself in brightness. Buildings piped for ordinary gas need not have the same changed for acetylene, the addition of acetylene burners being the only change needed. Acetylene, on account of its clear, white light, is best adapted for showing tints and colors of all classes of goods, and is, therefore, very valuable for merchants in dry goods, jewelry, art stores and galleries, and for social entertainments, libraries, yachts, work boats, steamships, etc. Search lights or reflectors will be furnished if desired, and are of great value for mining and all kinds of night work. For further information, we advise those interested to write to Mr. L. J. Wing, 109 Liberty St., New York City. Mr. Wing is also well-known as the manufacturer of the Wing disc fan, high speed steam engines and marine and stationary gas and gasolene engines.

MAGNETISM.

SATURATION AND COMMUTATION.

Cast iron, mits metal, steel and wrought iron have been used extensively in the construction of dynamos and

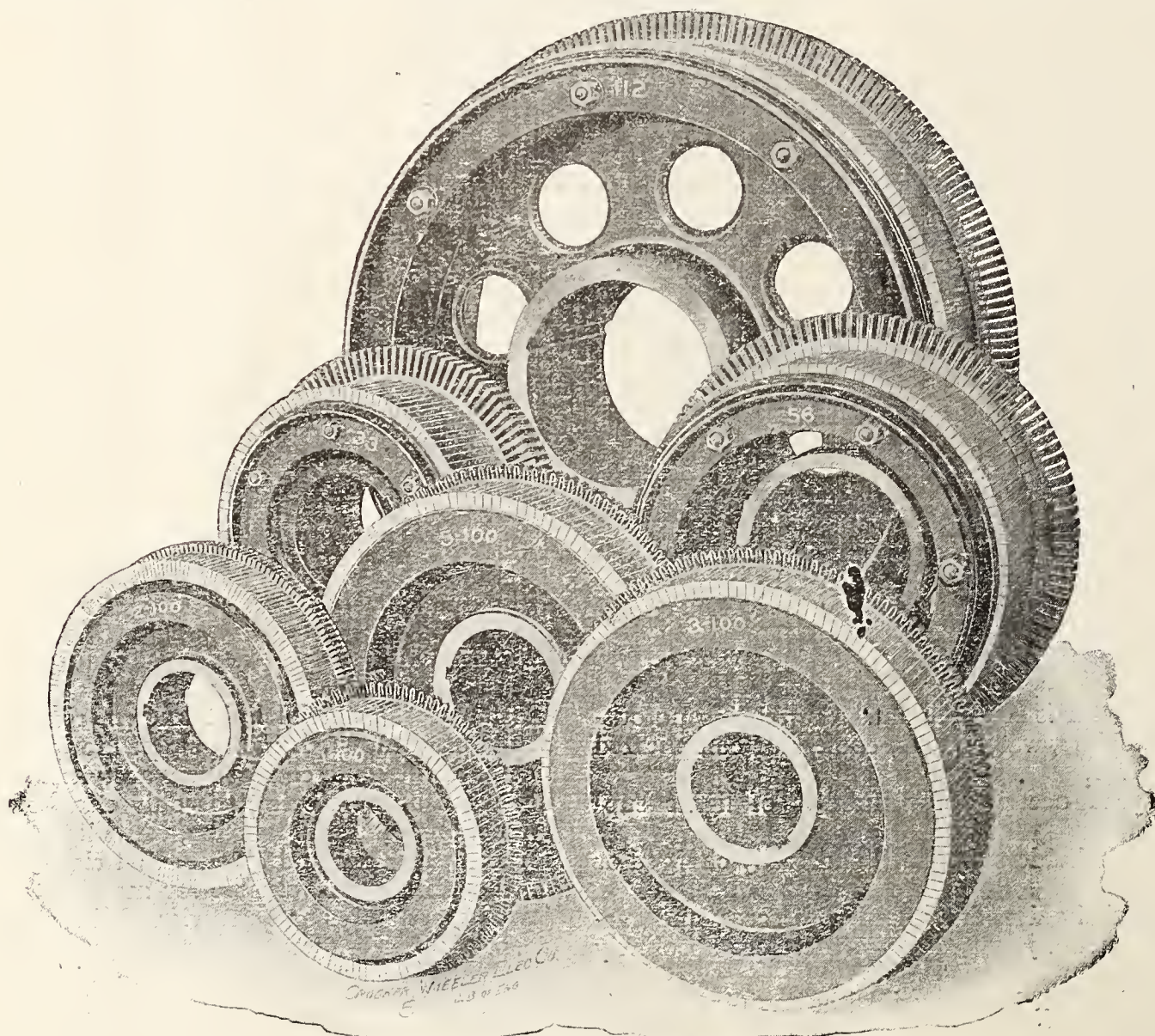
dred and sixty. If the iron contained a few per cent of aluminum the ampere turns reduce to one hundred and twenty-eight at the same point of saturation. For mits metal about fifteen ampere turns per inch length would be required at this point of saturation, and so on for the other metals in rapidly increasing figures. It seems established by practise and theory and proven by the dol-



Frames.

motors for the past ten years. The mooted question from which has sprung a multitude of uncertainties is that of the point of saturation at which it is most economical to

lars and cents it costs to think otherwise that cast iron cannot enter the field of dynamo design without causing possible bankruptcy to manufacturers. On the contrary,



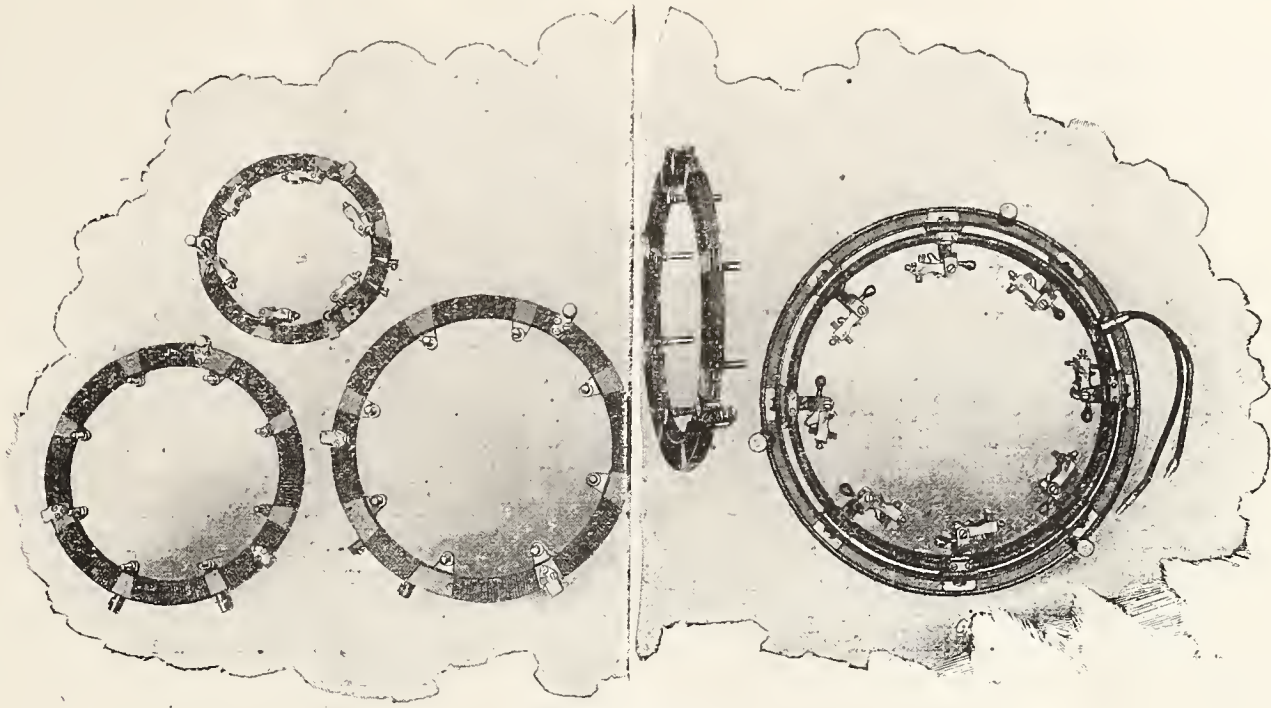
Commutators for Direct Machines.

magnetize these various metals. The ampere turns required for one inch length of cast iron magnetized up to fifty thousand lines of force per square inch are one hun-

annealed iron and cast steel are so closely related, their points of saturation so high and the degree of economy with which they can be used so great that no question

ever arises as to the direct benefits derived from their use. The point of saturation for cast steel is about eighty thousand lines of force per square inch. For wrought iron generally one hundred thousand. The ampere turns required for inch length of cast steel at eighty thousand lines of force per square inch are thirty-four. At one hun-

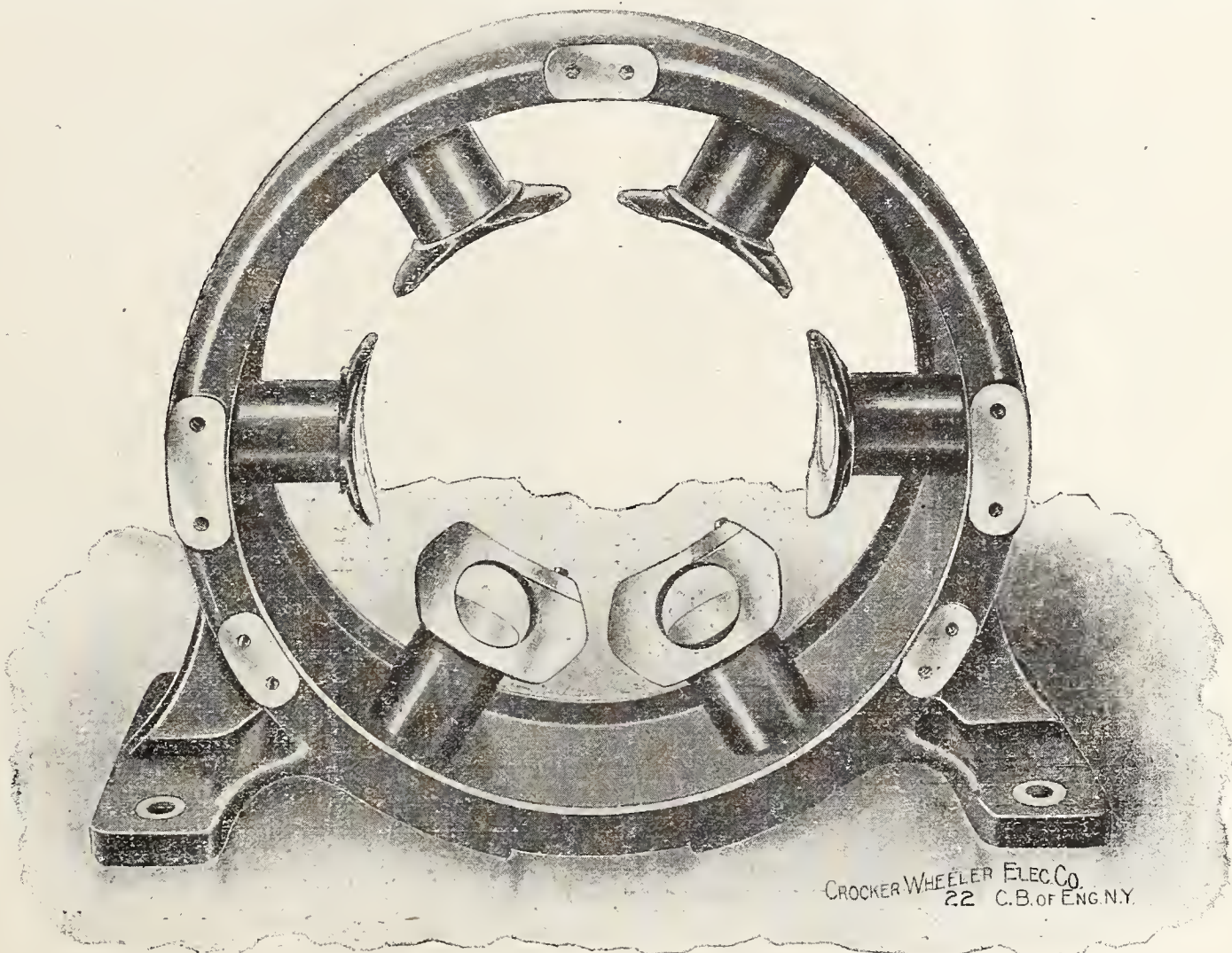
means a great saving in weight and cost of construction which manufacturers would do well to take advantage of in every case. The commutators built up in different sizes have been brought to a point of great mechanical perfection. They are electrically perfect as well, each segment carefully calculated as to its carrying capacity and



Brush Riggings.

dred thousand lines of force per square inch the ampere turns required for inch length are one hundred, whereas for wrought iron at this point of saturation they are only ninety-one. It is evident that cast iron at eighty thousand lines of force per square inch is much cheaper to use than wrought iron at one hundred thousand. Consequently

surface coming in contact with the brush. In fact, commutators are built up and held in stock ready for all kinds of winding and any variety of design that may present itself. The failure in many motors and generators has been found largely in the design of the commutator and brush. To properly proportion these from three



Frame, Showing Method of Fastening on Pole Shoes.

we may regard that question as settled, and in looking over the various types of machines, particularly those illustrated, realize that mild steel frames are particularly desirable. The use of removable pole pieces of cast iron

to five times the cross section of metal should be allowed at the rubbing surface of the brush and segment as is ordinarily considered sufficient for that number of amperes. One million circular mils per thousand amperes

is a good foundation to work upon. Starting with this practical assumption it is possible to design both commutator and brush so as to eliminate heat and subsequent deterioration at both commutator and brush. Careful attention to this point is the only means by which a smoothly operating and efficient piece of machinery can be produced.

ELECTRIC LIGHTING.

A LETTER FROM A HEIDELBERG STUDENT ON THE NERNST LIGHT.

To the Editor of Science: Several months have passed since the report of the discovery of a new incandescent electric light by Professor Nernst, of Göttingen. It was rumored that a Berlin firm had bought the patent for five million marks, and that we were on the eve of another revolution in the illuminating industry, but till recently very little reliable information has been obtained. In the meantime Professor Nernst has been developing and perfecting his invention; and his researches have been crowned with such success that we may look forward to the early appearance of the finished lamp, and perhaps the confirmation of the most sensational rumors.

The astonishing progress in illumination during recent years has been characterized by a great race between gas and electricity. Scarcely had the incandescent light secured a firm hold in the practical world when Auer von Welsbach made his famous improvement on the gas light, and the possibility of the use of acetylene became apparent, so that many believed that electricity would after all have to yield the supremacy to gas. Nernst now reclaims the palm for electricity, for he expects that the cost for his light for a whole evening will be no more than that of the Edison for an hour.

The Nernst light requires neither vacuum nor tender filaments. The essential point of the invention is that when substances like magnesia (magnesium oxide) and clay are heated above 3,000 degrees Celsius (6,000° Fahr.—far above the melting point of platinum) a very weak current is sufficient to keep them in an intensely luminous condition. Either direct or alternating currents may be employed, and the magnesia is little injured by use. The only difficulty that remains to be surmounted is a practical and inexpensive appliance for heating the substance to the necessary temperature. The work is, however, progressing and those who know the ability and courage of the inventor are confident that he will succeed.

Professor Walter Nernst, though unknown to most people, is a scholar of high rank in the purely scientific world, and his works or their translations are to be found in almost every scientific library. His brilliant researches won him the newly established chair of physical (theoretical) chemistry at Göttingen, and he is surrounded by advanced students of the most varied nationalities, all of whom greatly admire his fertile mind and genial, inspiring manner. His new invention is but another example of the benefit that patient, conscientious scientific study is sure to bring to the whole world.

H. C. COOPER.

Heidelberg.

BUSINESS NEWS.

AN OFFICE BUILDING FOR THE ELECTRICAL TRADE.

The advantages and conveniences secured by having offices situated in the immediate vicinity of the electrical and kindred trades is becoming more and more apparent to the manufacturers of electrical and mechanical apparatus, desirous of centrally located headquarters. The

tendency among the manufacturers of machinery, etc., appears to be growing more and more in favor of well-appointed suites of offices in preference to the formerly universal practice of large stores containing the various types of machinery, etc. While the latter practice is, of course, looked upon with a great deal of favor among those manufacturers having their works in the Metropolitan district, still it does not recommend itself to the out-of-town manufacturers who are put to a heavy expense in fitting up large stores, this expense being hardly commensurate with the advantages entailed thereby. The erection of modern and up-to-date office structures in the downtown district and the steadily increasing electrical colony in the same, has, to a large degree, solved the problem of proper headquarters for manufacturers of electrical and mechanical apparatus, etc. One of the latest arrivals, so to speak, and probably the best equipped is the White Building, 95-97 Liberty street, New York City. This is a twelve-story fire-proof building, and is situated on the north side of the street, between Broadway and Church. It has an imposing granite front, and is constructed entirely of brick and steel, with an iron frame. The floors are marble, entirely fire-proof, halls beautifully tiled, and the whole interior of the building presents an agreeable and harmonious sight to the visitor. The building is equipped with two Sprague electric elevators, which are run day and night for the convenience of tenants. Tenants can have rooms on any floor, either single or en suite. All rooms have plenty of daylight besides being equipped with electric lights, the power for which is generated by a plant in the basement of the building. This plant consists of two 50 K. W. and one 25 K. W. Eddy dynamos direct connected to Russell engines, and was installed by the Russell Engine Company. The wiring was installed by the Conduit Wiring Company, of this city, and was done according to the latest and best specifications. Among a few of the tenants having offices in this magnificent building are the Fostoria Electric Company, Locomotive Publishing Company, James H. Lancaster, Sterling Boiler Company, Brooks & Co., Albert A. Cary, Consulting Engineer. We would advise those of our readers seeking offices in a desirable location and up-to-date building to pay a visit to the White Building and examine its many excellent features. For offices, terms, etc., apply to the agent, Mr. John N. Golding, 9 Pine St., and 543 Fifth ave., City.

ELECTRIC LIGHTING IN CANADA.

Prescott, Ont.—The consulting engineer, Mr. John Galt, is preparing plans and designing a system of water-works, sewerage and electric lighting for this town. Commissioners will be appointed at the forthcoming January elections and work will proceed during the year 1899.

Sherbrooke, Que.—The North Hatley Electric Light Company have purchased the water power on the Magog River and propose to supply light and power to this city.

Ottawa, Ont.—L. K. Jones, secretary, Department of Railways and Canals, invites tenders up to the 21st for the construction of a power house and the installation of electrical apparatus for operating the locks, bridges and other structures, and lighting the Soulanges Canal.

Halifax, N. S.—A special committee has been obtaining information as to the advisability of the city undertaking its own street lighting, and, as a result, the city engineer and electrician have been instructed to make plans and invite tenders.

Acton, Ont.—The by-law to provide \$6,000 for the purchase of an electric light plant has received the sanction of the ratepayers. Arrangements will be made for the installation of the plant.

Pembroke, Ont.—The report of Mr. R. J. Parke, of Toronto, on the cost of installing a municipal electric light plant, will be presented in a few days.

Thorold, Ont.—The Electric Light Committee has recommended the extension of the electric light plant as far as possible under the present conditions.

Nelson, B. C.—The judge has quashed the by-law which authorized the Council to borrow money to purchase the electric light plant from a private company.

Brampton, Ont.—The agreement between the Hutton Electric Light Company and the corporation for the lighting of the streets has been signed by the Mayor.

Hull, Que.—The report of the Electric Light Committee was last week referred back by Council for more detailed information as to the cost of installing a plant.

Fort William, Ont.—The appointment of superintendent of electric light plant has been given to Mr. W. H. Smith, of Goderich.

Thorold, Ont.—The tender of the Royal Electric Company for addition to electric light plant has been recommended for acceptance.

Moncton, N. B.—The town is considering the question of making some extensive changes to its electric light plant.

Mitchell, Ont.—The by-law to raise \$5,000 by debentures for improving the electric plant was defeated by the ratepayers last week.

Lake Megantic, Ont.—The Electric Light Company have purchased property on which to erect their power house.

J. ALCIDE CHAUSSE.

TOTAL ELECTRICAL EXPORTS FOR WEEK ENDING DEC. 13, 1898, \$33,855.00.

New York, N. Y. Dec. 13, 1898. The following exports of electrical material are from the port of New York for the week ending this date:

Argentine Republic—200 packages electrical material, \$8,447. 89 packages electrical machinery, \$9,203.

British West Indies—63 packages electrical material, \$3,135.

British Possessions in Africa—16 cases electrical material, \$275.

Brazil—1 case electrical material, \$24.

British East Indies—5 cases electrical machinery, \$183.

Bremen—8 packages electrical material, \$1,791.

Cuba—29 packages electrical material, \$641.

Ecuador—1 package electrical material, \$12.

Hayti—2 cases electrical material, \$207.

Hamburg—62 packages electrical material, \$3,089.

London—31 packages electrical machinery, \$4,504.

Odessa—4 cases electrical material, \$110.

Porto Rico—26 packages electrical material, \$1,213.

St. Petersburg—4 cases electrical machinery, \$983.

Venezuela—1 case electrical material, \$38.

NEW INCORPORATIONS.

Louisville, Ky.—The Carter-Hays Electric Company, incorporated by E. W. Hays, Hugh Hays and L. D. Carter, to manufacture and repair electric appliances and construct electric plants. Capital \$5,000.

New Orleans, La.—The Merchants' Electric Light and Power Company, organized with M. Ber, president, Joseph Simon, vice-president, E. W. Goldschmidt, secretary-treasurer and manager; for the purpose of erecting a plant to supply electric light and power. Capital stock \$300,000.

Millbrook, N. Y.—Millbrook Gas and Electric Company has been incorporated with a capital stock of \$15,000.

Jersey City, N. J.—Dennison Motor Carriage Company, incorporated by Geo. L. Record, Ernest Merrick and J. F. Dennison, to manufacture engines and electrical and other motors. Capital stock \$100,000.

Richmond, Ky.—The Richmond Electric Light Company has been organized by Frank Adair and others.

Spartansburg, S. C.—Julius L. Carson and others are forming a company for the purpose of building a plant to furnish electric lights and power.

Adairsville, Ga.—Joe. P. Bowdoin will construct a telephone system.

Crescent City, Fla.—The Fruitland Peninsula Telephone Co., incorporated.

Petersburg, Va.—The Long Distance Telephone Co., has received franchise for telephone system.

New York, N. Y.—The United States Automatic Telephone Co., has been incorporated by Elias E. Ries, Martin Lowenstein, Henry A. J. Milhens, Israel Steinhart, and Henry J. Furlong; to manufacture and deal in telephonic and electrical apparatus. Capital stock \$1,000,000.

Ewing, Ky.—Flemingsburg and Myers Station Telephone Co., has been incorporated by I. B. Sherwood, W. R. Darinell, Robert Harper, I. N. Price, and W. J. West; to do a general telephone business. Capital stock \$600.

Hinckley, Ill.—Northern Illinois Telephone Co. has been incorporated by F. A. Graves, M. D. Patten, and F. B. Patten. Capital stock \$10,000.

Monroe, N. C.—W. S. Lee, J. M. Belk, and R. A. Morrow are organizing a company to establish a telephone system.

Pocomoke City, Md.—The Worcester Telephone Co., directors have decided to extend their line to Pocomoke City, Stockton and other points in the country.

Mexico, Mo.—The Lafayette Telephone Co., incorporated by D. P. Moore and others; to construct and operate telephone. Capital stock \$12,500.

Beaver Falls, Pa.—The Pennsylvania Telegraph and Telephone Co., incorporated by H. C. Patterson and others. Capital stock \$50,000.

Waco, Tex.—Electrical Construction Co., incorporated by E. Rotan, W. W. Seley and others; to construct, maintain and operate telephone lines. Capital stock \$35,000.

New Bedford, Mass.—Automatic Telephone Company has been incorporated by J. W. Macomber and Frederick Tabor. Capital stock \$100,000.

Homestead, Pa.—The Homestead Telephone Company has been incorporated by G. Gladden, R. Kennedy, J. Purman, D. H. Carus, A. J. Kuhn, W. S. McConegby, and H. J. O'Donnell to construct and maintain telephone lines. Capital stock \$10,000.

Philadelphia, Pa.—The Farmers' and Merchants' Telephone Company has been incorporated by J. P. Darling, John Fischer, W. D. Kissner, T. L. Darling, J. F. Rees, and L. G. Rees to operate a telephone system at Warsaw. Capital stock \$5,000.

Benton, Mass.—Youngblood-Stampers Telephone Company, incorporated by R. A. Youngblood, F. H. Stampers and N. H. Youngblood. Capital stock \$12,000.

Salt Lake City, Utah.—The Thompson and Moab Telephone Company has been incorporated by Arthur A. Taylor, president; J. C. Taylor, vice-president; Robert James Thompson, treasurer, and Charles Wilson, secretary, to build and operate a telephone line between Thompson and Moab, Utah. Capital stock \$1,400.

Lexington, Tenn.—Lexington Telephone Company, incorporated by J. E. Melead, H. E. Cruper and others. Capital stock \$200,000.

Berea, Ohio.—The Citizens' Telephone Company has been incorporated by S. B. Rawson, J. A. Duke, F. W. Martin and T. M. Brush, to operate a local telephone system. Capital stock \$20,000.

Columbia, Mo.—Columbia Telephone Company has been incorporated by James A. Hudson and others. Capital stock \$5,000.

Shelton, Conn.—The Russell-Tomlinson Electric Company has been incorporated by G. G. Milne, C. B. Barker, W. W. Tomlinson and W. E. Russell to manufacture, buy, sell and deal in electrical goods and wares. Capital stock \$20,000.

STREET RAILWAY NEWS.

Chattanooga, Tenn.—The Chattanooga Electric Railway Company filed mortgages with the County Register to the amount of \$625,000 in favor of the Maryland Trust Company.

Bloomfield, Mich.—The Bloomfield and Orchard Lake Electric Railroad has been incorporated by George L. Hendrie and others with a capital stock of \$50,000.

Hartford, Conn.—F. W. Siebert, Edward W. Shedd and C. Siebert will apply to the incoming Legislature for a charter to build an electric railroad in Cromwell.

Pottstown, Pa.—The Montgomery and Chester Electric Railway Company has been incorporated by W. H. Grebe, C. S. Jarvis, G. G. Fitler and others to construct and operate an electric railway from Pottstown to Phoenixville. Capital stock \$300,000.

Washington, D. C.—The Columbia Railway Company will change the existing construction of cable road to underground electric system.

Cincinnati, Ohio.—A stock company has been organized to build an electric road from Cincinnati to Lebanon, a distance of 25 miles.

Hartford, Conn.—The Central Railway and Electric Company has been granted permission to extend line.

Pine Bluff, Ark.—The Pine Bluff Electric Light and Street Railway Company, incorporated with Jeff Hicks, president, T. L. Chadbourne, Jr., vice-president, and H. H. Hunn, secretary-treasurer. Capital \$300,000.

West Chester, Pa.—George F. P. Wanger is at the head of a company which has just been granted a charter for a proposed electric railway from Pottstown to Phoenixville.

Hamilton, Ohio.—The Hamilton and Eaton Electric Street Railway Company, incorporated with a capital stock of \$10,000.

BUSINESS CHANGES.

Chicago, Ill.—The Victor Electric Company increased capital stock from \$2,400 to \$6,100.

Rockford, Ill.—The Rockford Railway Light and Power Company has certified to increase from \$250,000 to \$350,000.

Wilmington, Del.—The Wilmington City Electric Company reported to have been purchased by the Pennsylvania Manufacturing Company, of Philadelphia, who will assume control.

NEW YORK ITEMS.

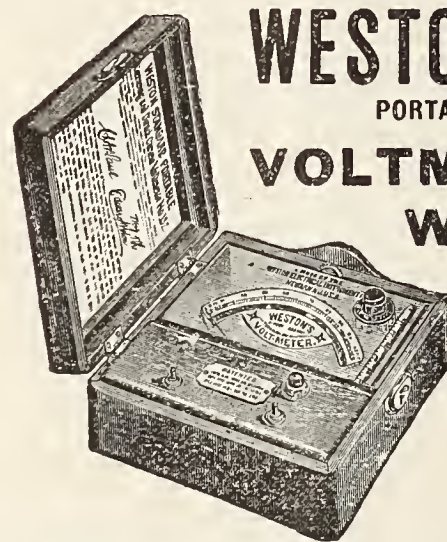
ZIMDARS & HUNT, 127 Fifth avenue, are obliged to keep their factory running day and night in order to keep up with the demand for their electric light and power specialties.

JAMES R. WILEY, the western manager of the

Standard Underground Cable Company offices at the Rookery, Chicago, is in town visiting.

GEORGE L. WILEY, the eastern manager of the Standard Underground Cable Company, Telephone Building, reports business as being first-rate and the outlook for the coming year most excellent.

ALBERT A. CARY has opened up an office as consulting mechanical engineer at 95 Liberty street. Mr. Cary intends making a specialty of steam plants, designing, erecting, reconstructing, testing, etc. He has made the waters for steam boilers a special study and is prepared to analyze and purify them. He has no special apparatus or compounds to accomplish the above purpose, but assumes a purely consulting position with all clients having troubles of this kind, and places them in a position to be able to use waters which have been causing trouble. Mr. Cary's writings and discussions are doubtless familiar to many of our readers. After many years of experience with boilers in all parts of the country Mr. Cary has built a large number of furnaces to burn all kinds of fuel with high economy and is, therefore, prepared to help and advise those needing assistance in this direction. He has also been of assistance to lawyers and clients in working up cases involving steam and mechanical appliances. Mr. Cary's methods of working up such cases differ considerably from those usually employed by expert engineers, as he takes charge of all details of the case, thus saving both lawyer and client considerable time and labor.



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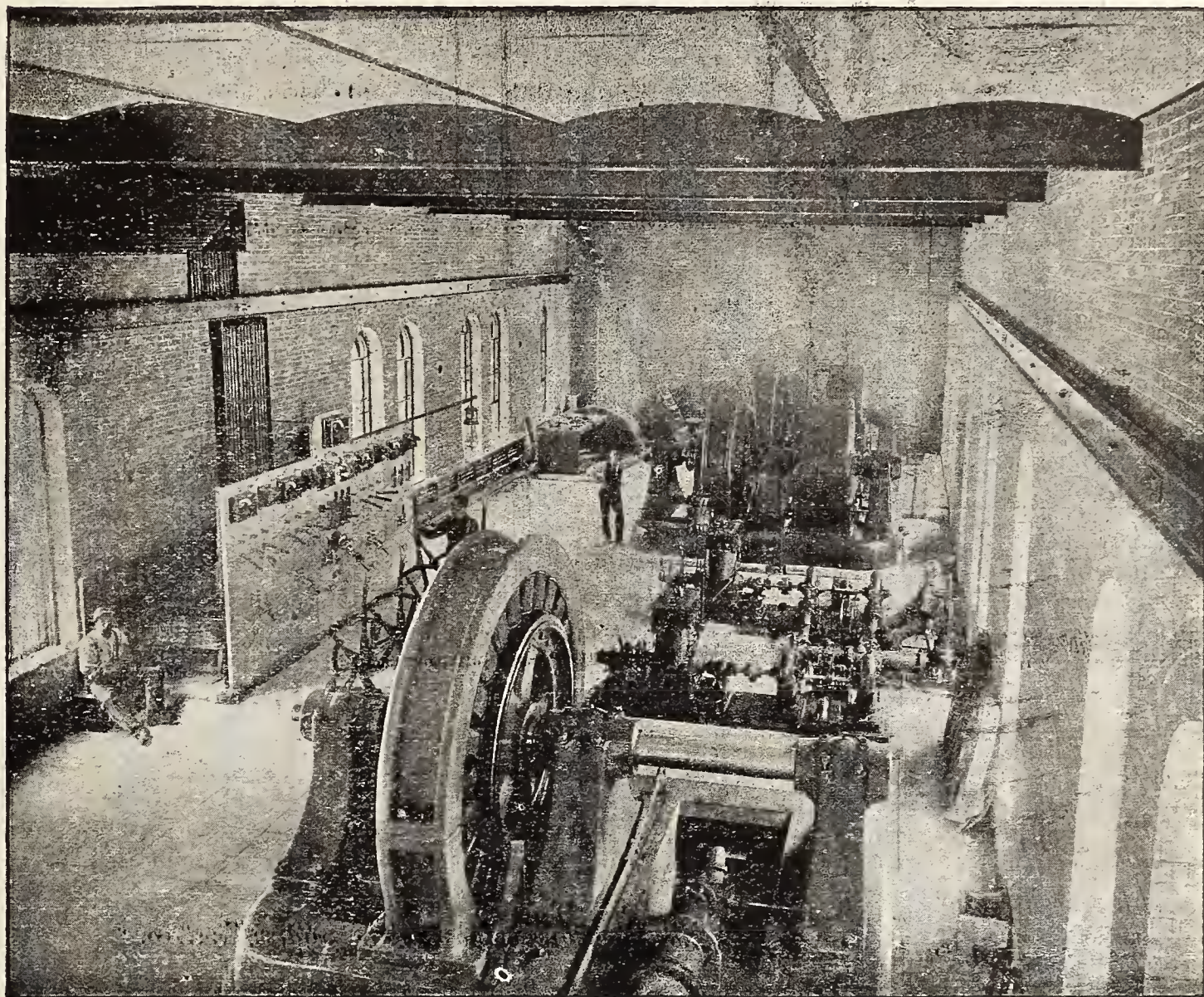
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POWER TRANSMISSION.



Interior of the Big Cottonwood Plant.

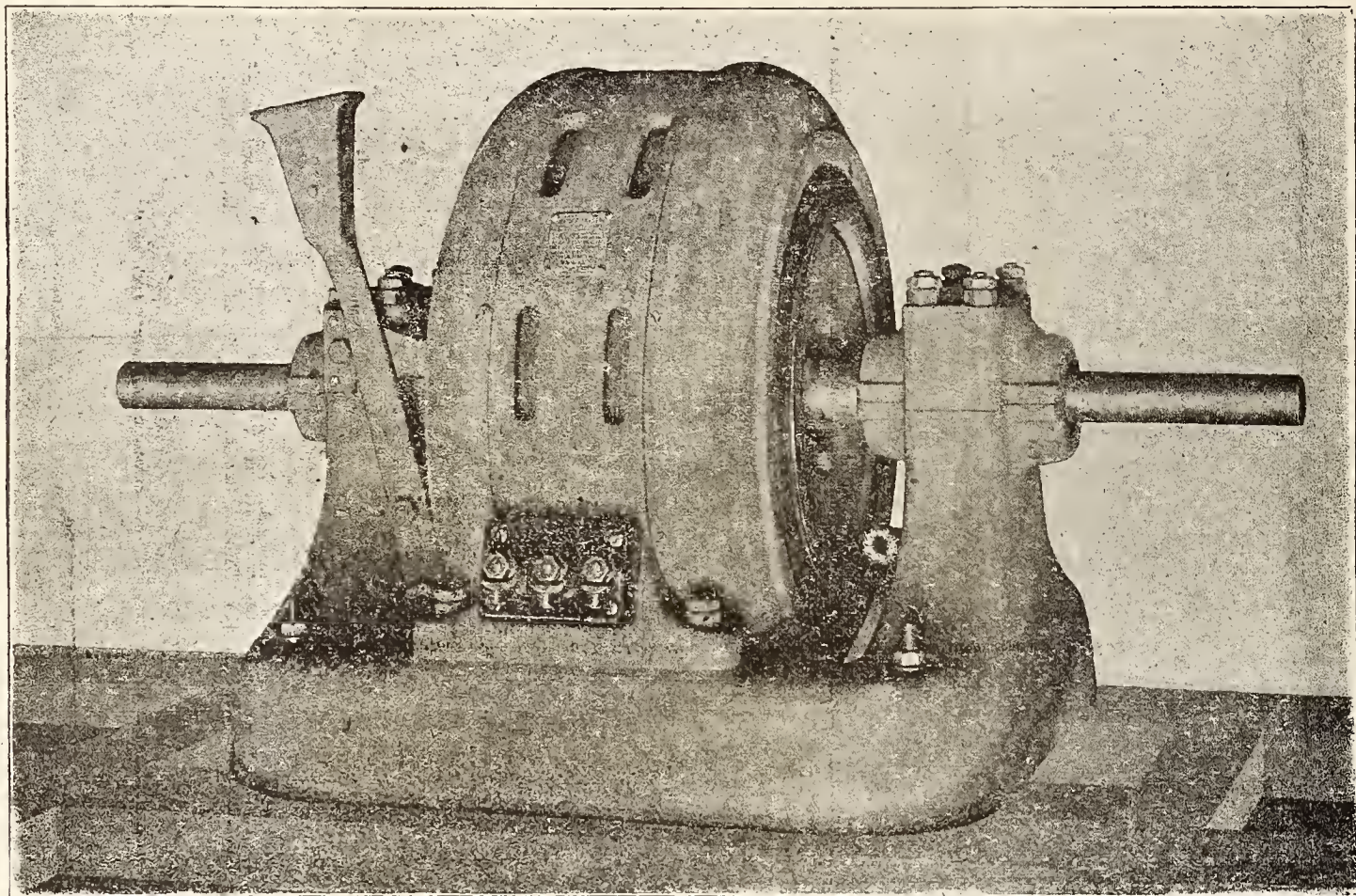
THE TRANSMISSION OF HIGH AND LOW VOLTAGES.

Enormous electro motive forces are being used at the close of this century for the purpose of efficiently transmitting electrical energy. These pressures, of course, necessitated an improvement in the construction of insulators and various other modifications in the ordinarily accepted system of power transmission. The recent work of Mr. Charles S. Scott, written under the title "High Voltage Power Transmission," cannot fail to impress the reader with the radical changes that have occurred, both as regards pressure and system. The outlines of power transmission prove from a theoretical standpoint that out of 100 per cent. mechanical energy delivered at the generator pulley, only 73 per cent. is obtained at the distant motor end. This means an allowance of 10 per cent. loss in the generator, 10 per cent. loss in the line and another 10 per cent. at the receiving end at the motor. The three governing factors are pressure, distance and size of copper conductors. Many modifications can be

made of the relationship existing between these three factors. A high electro motive force is not always desirable unless circumstances allow of a line construction that makes safety self-evident. The first attempts at power transmission since the preliminary experiment of Marcel Deprez have been eminently successful. But since that time the voltage has risen by leaps and bounds. Although the three factors previously mentioned exercise a considerable influence over the output at the end of the line, it must not be forgotten that the frequency is of equal importance from a theoretical, as well as a practical, standpoint. Therefore, like the three musketeers of old who were made famous by a fourth, the pressure, distance, size of conductors and frequency are all important. Where water power is available or other natural forces can be utilized the transmission of power does not always involve the generation of high potentials. It frequently happens that the electrical side of the question becomes

insignificant in comparison with the mechanical. Possibly turbines cannot be installed or lines cannot be erected

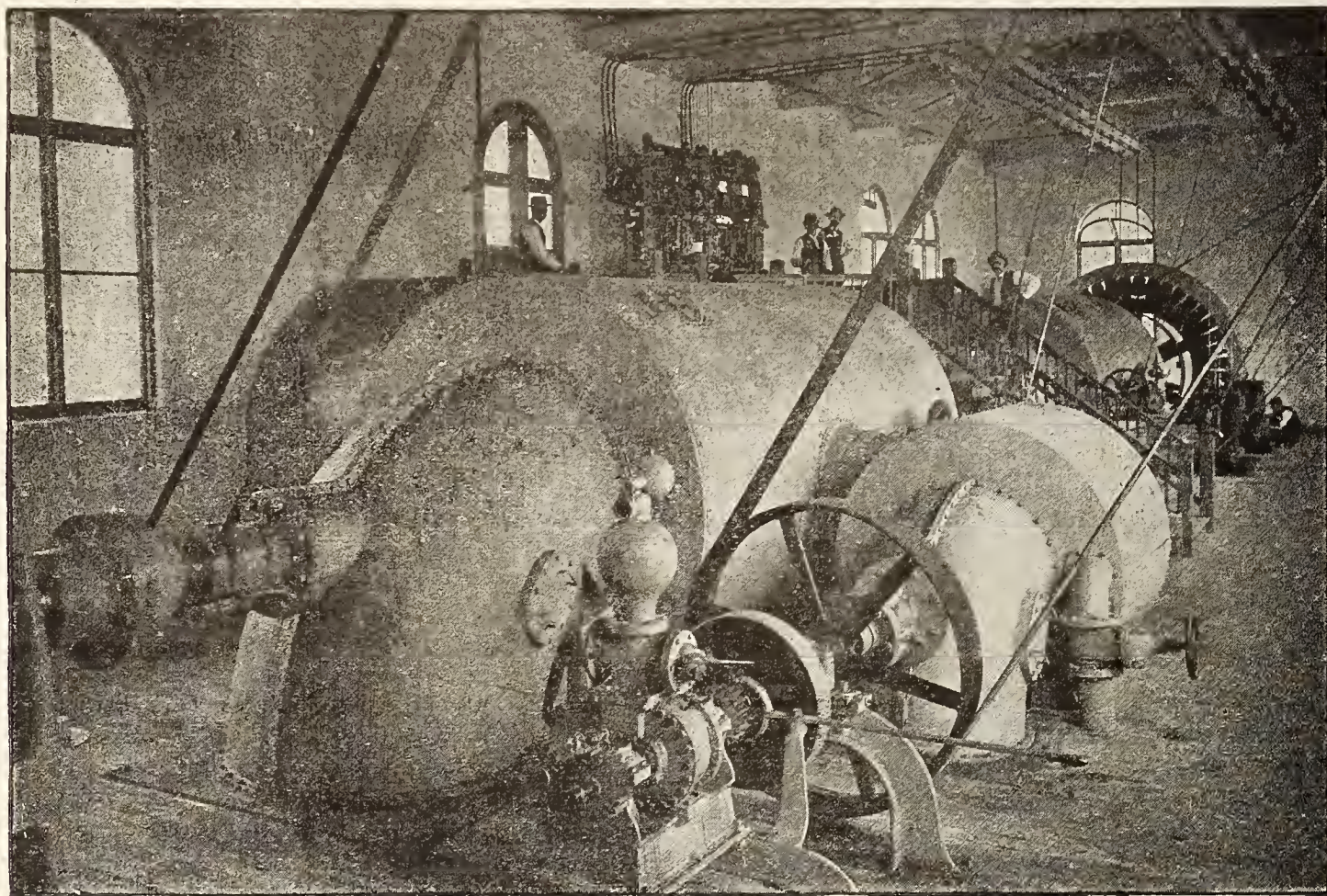
helpless in the face of such discouragements, but provided conditions are propitious high and low-tension and



Suspension of Motor in Columbia Mills, S. C.

and inspected on account of the wilderness through which they pass; then again, climatic changes, storms, snow

transmission power plants are more than successful in the great majority of cases. The illustrations show



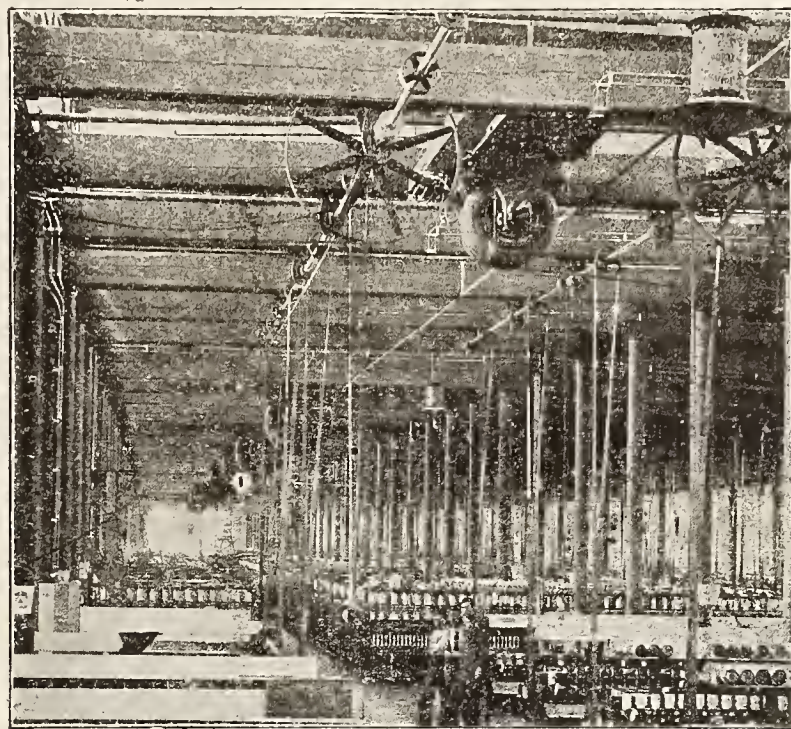
Turbines at Pelzer, S. C.

and ice may entirely remove the possibility of keeping the plant in good working operation. Science may be

cases where installations have been made with considerable success. Of course, the nature of a plant

changes considerably on account of the pressure used, as well as the phase and frequency. In Mr. Scott's tests he discovered that rubber covered wire decreased the loss considerably, probably on account of

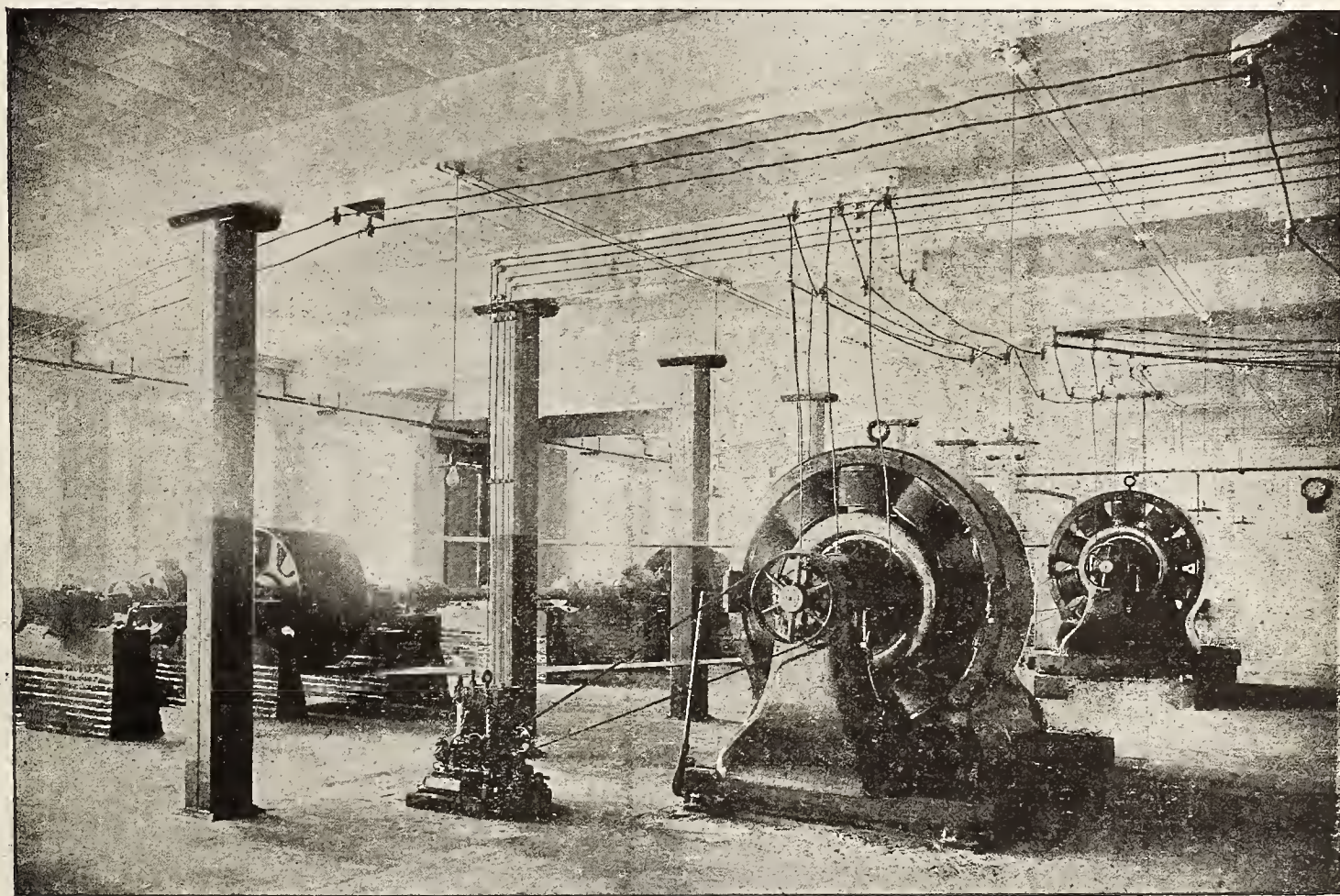
pressed every variety of design in glass and porcelain. They were exposed to a pressure of one hundred thousand volts, falling to a minimum of 70,000 for six weeks. Although the lines were exposed to heavy rain storms a



Spinning Room, Columbia Mills, S. C.

this superior insulation. He also noted that after a rain, although the insulators were wet, a pressure of from 45,000 to 60,000 volts quickly dried them, and improved

steady pressure of forty-eight thousand volts was sustained. The results in all these tests were very favorable and bring about the conclusion that, although low volt-



Interior of Taftville Generator Room.

their insulating properties. Tests were made on four lines in multiple, each line composed of two wires supported by twenty-six insulators. These insulators ex-

age power transmission has always been assumed to be a success, as far as insulation is concerned. It is not superior to high tension transmission in this respect, even with

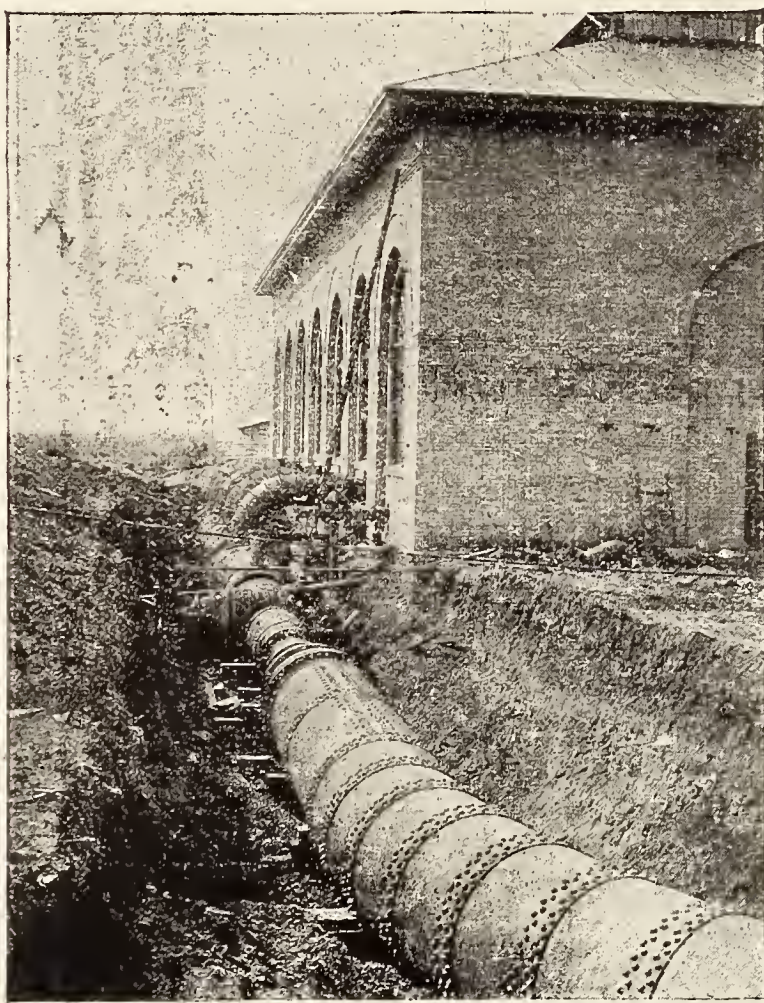
enormous pressures, as quoted above. The improvement in transformers, which includes the use of oil for insulation, coils possessing large surface for radiation, the windings divided into a number of sections and a close regulation, have added great stimulus to the growth of power transmission plants. Manufacturers will guarantee high potential transformers with a range of from one hundred to forty thousand volts and more, if necessary. Power transmission by means of a continuous current is a rather more complex problem, due to the lack of a simple transforming device. Two and three phase generators and motors have so altered the situation that prejudice has absolutely ceased as regards the commercial success of their application. The final triumph has been the supplying of street railways with electric power, taken from a distant waterfall, and strange as it may seem, power is now sold as any other staple article, having a definite market value. With the new century there is still more to be expected in this, as well as other kindred fields.

the machines may be said to have been grouped. Another letter comes from Wakefield, where Messrs. Green & Son's works have been changed during the past two years to electrical driving. The writer, however, is so hopelessly involved and mixed in style and figures, that it is impossible to pick out anything from the letter.

TELEPHONIC.

TELEPHONE AND TELEGRAPH ON ONE WIRE.

The first telephone test of the new copper wires of the Baltimore & Ohio, between Pittsburg and Baltimore, took place on November 21st, says the "Telegraph Age." It was gratifying in its result and entirely successful in its working, and the use of the wires for simultaneous telegraphing and telephoning will, according to the original purpose, be made a permanent



Exterior of Pioneer Plant, Showing Pipe Line.

ELECTRICAL POWER TRANSMISSION.

Replying to a rather over-cautious article in the "Engineer" on "Electrical Transmission," Mr. Hart, of the De Laval Separator Works, of Poughkeepsie, tells how he had a rapidly extending works to deal with, in which a number of lay shafts, extending in length each 150 feet and 20 feet apart. He was obliged to put in electrical transmission, as the work became too great for his power, and this was done by laying down a boiler and two dynamos, one being driven by the spare engine. One shaft after another was thrown upon the new system, and finally, with the same engine and electrical transmission, much more work was being done, as regards machinery driven, than was formerly the case, and several motors were 400 feet away from the engine. It was found very easy to add one motor after another. Moreover, the old system of shafts was still preserved. The difference was merely in the driving of the many parallel shafts on which

feature of the many Baltimore & Ohio improved facilities for transacting business. The complete success of the first trial was a gratifying surprise. The voice sound from distant points was as distinct as that of the ordinary local telephone at short distances. The test was made over the wires during the time that messages were passing over them between Pittsburg and Baltimore, and Baltimore and Newark.

The tests were in charge of I. S. Hare, chief operator at Pittsburg; Charles Selden, superintendent of telegraph and E. J. Little, chief operator at Baltimore, Md. As these officials are telephone as well as telegraph experts, the success which they announce is doubly significant.

The test was made over the new wire recently strung between Baltimore and Newark, Ohio, via Pittsburg, and the one from Baltimore to Pittsburg. These wires are used for telegraphing purposes, the former being duplexed.

The Electrical Age.

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THE AGE OF AUTOMATIC DEVICES.

The principles that have been crystallized in science for industrial purposes are comparatively few, although the different phases of invention and mechanical combinations indicate the use of more than one in many important inventions. In the practice of medicine the drugs used do not amount to more than a dozen, but their proper application, their judicious use, are quite sufficient to stop the inroads of disease and effect many important cures. In the world of scientific activity, in steam, electricity, chemistry, etc., there are not many more principles used than the aforesaid dozen. In fact, in all branches of science that lean towards the field of industry and in which prominent names appear connected with the origination and development of important devices, it is surprising to realize how great an influence a fundamental idea will exercise over that department of science, the value that attaches itself to that particular branch and the suddenness with which it springs into view. Perhaps there is no more interesting stage of development to

be noted in the engineering world than that which relates to the use of automatic devices. We are fast approaching an age of push buttons. The push button elevator has appeared, the push button switch, and in the purely mechanical field two of the most important inventions have been the familiar typewriter, with its keyboard of push buttons, and the great linotype machine, similarly equipped. A device has been perfected such that the mere pressure of a button immediately and effectively stops the largest of steam engines. All of this seems to be but a magnificent eulogy of nature. We see in her, by the means she takes to create nerve systems in tissues, the centralization of the most important nerves in so-called ganglions and their ultimate co-ordination in the brain of whatever creature or species exercising these functions, only a positive illustration of what we have just discovered and have not ceased to regard as wonderful. The button needs the touch of man to set into operation the forces under its control. The brain itself is composed of small areas to which impressions pass and from which they are sent—the sensory or motor nerves, the one carrying the impression, the other sending or causing to operate the actuating force. Our nervous centers effected by natural influences, internal and external, represent in many respects the points from which radiate lines controlling circuits operating machinery, running multitudes of electric lights. Push buttons will play a great part in the future history of civilization, and they are always an indication of the completeness and perfect automaticity of the mechanism they control. This tendency of the human race to reduce work to a minimum by employing keys or buttons was first exemplified in the invention of the spinnet, the old fashioned piano of the sixteenth century. The idea seemed to be fascinating, and an immense amount of labor has been done since then by mere finger touches, by the simple pressing of a button. One of the great characteristics of electrical inventions is the ease with which they can be controlled in this manner. In fact, it is always with pride that the daily newspaper reporter refers to the way in which the President of the United States opened the World's Fair or the Electrical Show or the Trans-Mississippi Exposition, etc., by a touch of his finger. That has always been considered a great triumph, and we merely refer to it because it stamps the close of this century most emphatically as a period from which we look forward with absolute certainty to the universal use of automatic machinery. Not necessarily electrical nor even mechanical, but combination types, through the medium of which labor is so facilitated and work so readily performed that little that is desirable will be left for the imagination of mankind to deal with in the line of labor saving devices. We have not as yet reached our limit, and there is no reason why we should not presume to believe, as the past has shown, that new principles will be discovered—possibly new forces—and in consequence of these, inventions of so astounding and fascinating a nature that we dare not anticipate them. The world at present is ripe for such things. To-day we see through opaque objects, we telegraph and transmit power without wires, we use the tides and waves of the ocean and the waterfalls of the land, and in the majority of cases much of our success has been due to the employment of machinery which in a certain sense governs and controls its own action and operates with such smoothness and efficiency that we cannot help but say "It is finished."

Brussels has a 5-story telephone exchange building, costing \$193,000, and with commutators for 15,000 subscribers.—Ex.

ELECTRIC MINING.

ELECTRIC MINING APPLIANCES.

In the illustrations are shown some few outfits and appliances used in connection with electric mining. The Marvin electric drill, shown with full connection, including the generator, shows the system of connections by

proper, the highest pitch of excellence is attained and a simplicity that leaves no room for criticism. The attractive power of a solenoid which depends upon its ampere turns gives to this device the power it requires for operation. The details of this have been carefully worked out so that the modern electric percussion drill, stripped of all elaboration, is unquestionably an able competitor of the best thus far constructed.

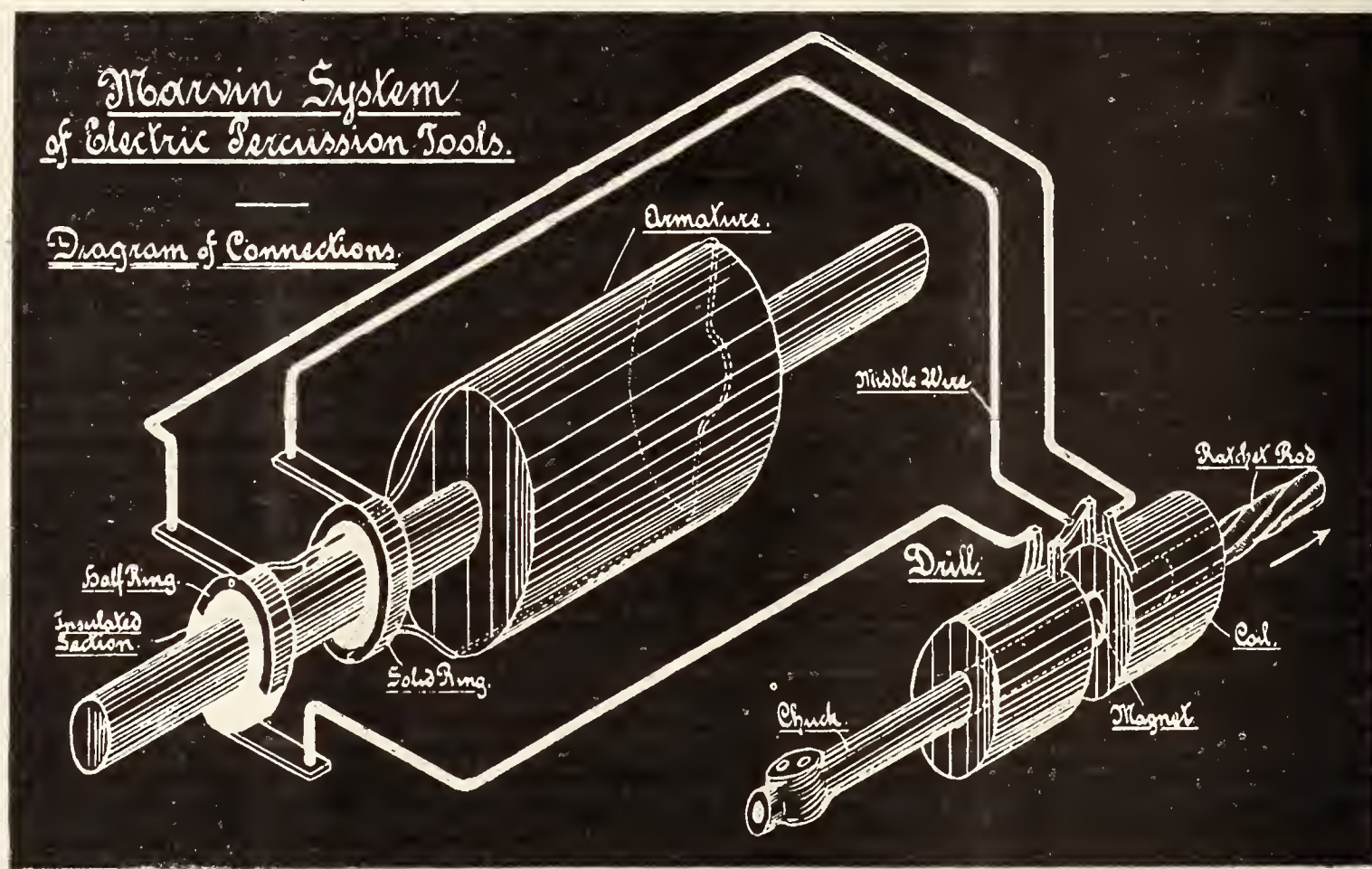


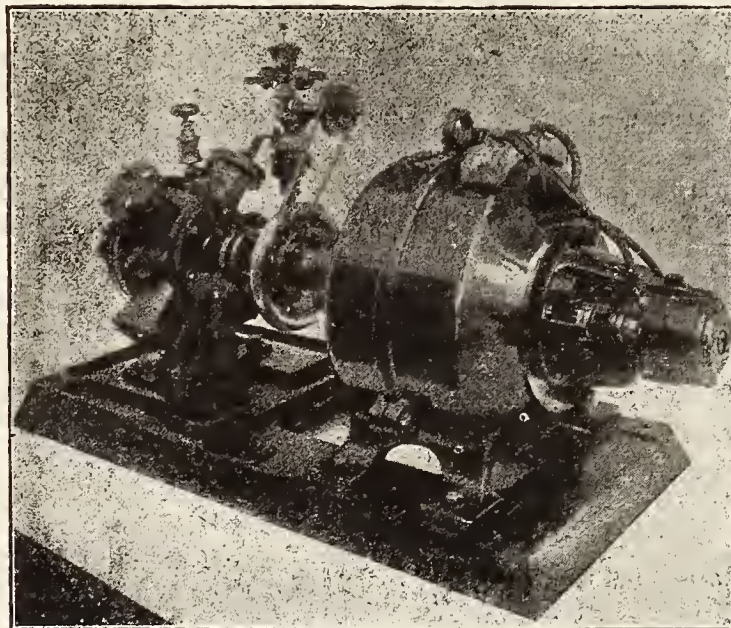
Diagram of Marvin Generator and Percussion Drill.

which the drill performs its function. A series of impulses pass in regular succession without the medium of either switch or commutator. By this means the drill is immediately made superior to those that are troubled with failing parts. A percussion drill, to be efficient, must be very carefully designed and constructed. The prejudice that once existed against them has practically

ELECTRIC LIGHT AND POWER.

PORTABLE ELECTRIC LIGHT PLANTS.

Those remembering the days of Barnum's circus will recollect the magnificent brilliancy of the calcium light.



An Up-To-Date Direct Connected Electric Light Plant.

died out, and the drill, as shown, has proven a complete practical success. The rotation of the armature sends an impulse of current first into one coil and then into the other. By being automatic in this wise and excluding catches, commutators, sliding contacts, etc., in the drill

To-day this is more than outrivalled by the sunlight glory of the electric arc, produced by a plant in which boiler, engine and dynamo are trundled along on wheels with less inconvenience than that associated with the lime light of bygone days. The illustrations place before the

reader's eye two types of compact electric light equipments. One of them to be drawn by horses, the other to be operated from any convenient steam supply; if necessary, one similar to that on wheels. There are many occasions in city life where accidents of various descriptions, public affairs of a civic nature and other events of importance call for sufficient illumination, which, in many cases, is noticeable by its absence. For such circumstances as these a portable electric light plant fills a position of great consequence. From a five to a ten horsepower plant installed, as shown, at least ten arc lamps could be operated, or five focussing lamps of five thousand candle power a piece. The system would be more convenient if the boiler was heated by means of oil, and the dynamo and engine were directly connected, as shown in the more modern plant composed of a Brotherhood engine and Lundell dynamo. The use of these installations have been suggested for military purposes during a land engagement, for instance, or to assist in the erection of temporary telegraph lines, the building of pontoon bridges and other forms of military engineering. Buffalo Bill uses portable electric light plants for the illumination of his famous Wild West Show.

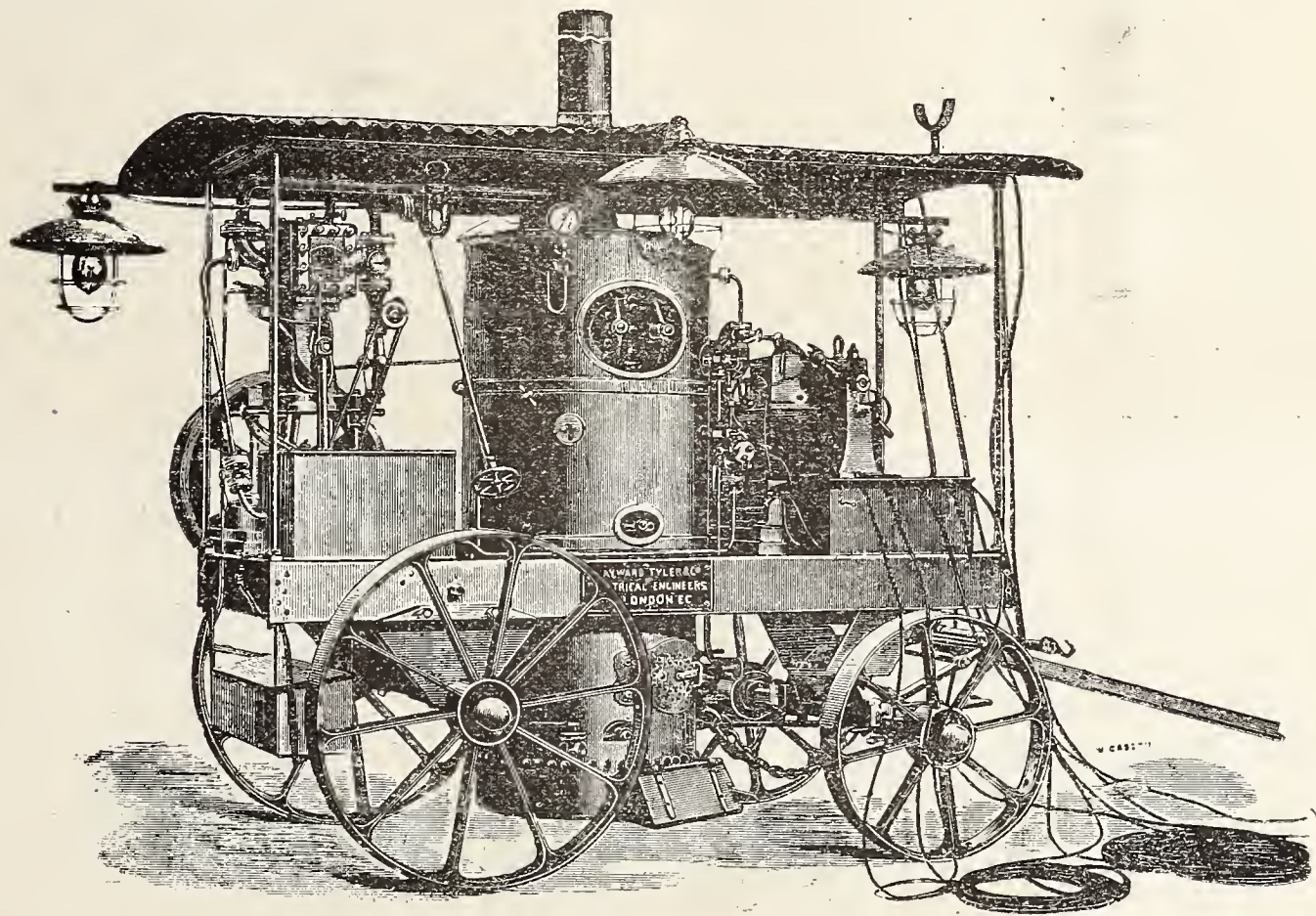
hand, advices from Alexandria are that the line is being pushed southward as fast as possible. The Sidar kept up complete communication between the front and Cairo, and now the news comes that the line is being carried towards Fashoda from Khartoum at the rate of four miles a day.—Ex.

AMERICAN ELECTRICAL GOODS ABROAD.

American lamps and other electrical goods are exposed for sale on the Brussels market, and are conceded to be superior to those imported from Germany, France and England, and with proper effort the trade in this line could be greatly increased. Especially in copper wire, insulated wire, large cables and arc lamps is there an excellent opening.—Ex.

SPREAD OF THE INDEPENDENT ELECTRIC MOTOR PRACTICE.

It is said that a new hardwood flooring factory, now being erected at Cadillac, Mich., will possess the unique characteristic of being destitute of shafting and of having but one driving belt—that one driving the dynamos. There will eight flooring machines and other tools neces-



A Portable Electric Light Plant.

MISCELLANEOUS SCIENCE. STRAY CURRENTS.

THE TRANS-AFRICAN TELEGRAPH.

It is reported that an expedition in charge of R. D. Mohun, bound either for Zanzibar or Mombasa, has already left Bombay. Under an agreement with the Kongo Free State, this party will construct a telegraph line from Lake Tanganyika to Stanley Falls, on the Upper Congo, the work being carried out under the commissions of the state. W. Cavendish, the well-known explorer, is already carrying the line northward through the extreme northern territory of the Chartered company, and it is confidently expected that he will form a connection with the Mohun line within the next two years. By that time the Tanganyika line will have reached Stanley Falls, and Cape Town will be in telegraphic communication with chief towns on the Upper Congo, or, in other words, half the length of the line which is to connect Cape Town with Cairo will be complete. On the other

sary in such a factory, each machine having an independent electric motor.—Ex.

ELECTRICAL CANCELING MACHINE.

An electrical canceling machine is being introduced into the post office at Youngstown, Ohio. The apparatus is run by an electric motor, and is capable of canceling 360 letters per minute. The machine is furnished with changeable type and a self-inking roller, and is fed somewhat after the style of a printing press, although less pains are required in getting the letters in straight. The mail matter is dropped into a trough at the bottom of which is a belt which carries the letters to the printing part of the machine, where the postmark, date and name of the city are printed on the letter. After the letter is marked it is carried by a continuous belt to a trough-like box, where the letters are delivered in the same manner as newspapers from a perfecting press.

GEOGRAPHICAL NOTES.

There are two meridians trending from one magnetic pole to the other where the variation is zero. One of these

meridians crosses the Atlantic ocean in a diagonal direction from the eastern part of South America and thence passes through North Carolina, Ohio and Michigan; it passed through London in the year 1657 and Paris 1669; the other crosses Australia, Western Asia and Eastern Europe.—Ex.

TELEGRAPHY IN CUBA.

The Signal Service Corps has begun the construction of a government telegraph line connecting Santiago with Manzanillo. The construction party comprises thirty-five officers and men and a medical officer. They carry provisions for two months. The wire will be stretched overhead along the road over which the Spanish general, Escario, marched his 3,500 men 170 miles from Manzanillo in ten days to the assistance of General Toral, when the Americans were before Santiago early in July. The line to Gauntanamo is almost finished, and will soon be in use. General Wood has ordered Captain Brady, of the Signal Service Corps, to begin the construction of a line to Holguin and Gibara immediately, in order that the headquarters of the department may be in touch with Colonel Hood's Second Immunes, who are stationed at Gibara, with which place there is now no communication except by coasting vessels.—Ex.

IN THE AZORES.

Prince Albert of Monaco is having an observatory built at the Azores for magnetic observations. The advantages of a station there will be its situation near latitude 40 degrees; artificial causes of perturbation, electric lighting, tramways, etc., will not be present; and the geographical position, intermediate between Europe and America, should furnish useful indications for comparison of the magnetic curves obtained on those continents.—Ex.

The establishment of a large electrical power plant, to be run by gas engines and to utilize the surplus gases from the by-product coke ovens, at Dunbar, Pa., has been proposed, and there is no reason why it could not profitably be done in a district where there is a demand for power. The suggestion is worth serious consideration from coke makers elsewhere. Power, considered as a by-product of the coke oven, may in many cases be an important and profitable one.—Ex.

LIGHTNING IN A MINE SHAFT.

In the "Annales des Mines (volume II., 1897, page 910), E. Fineuse says that at the Abhooz Colliery, near Haveny, on July 1st, 1897, a flash of lightning struck the iron pit-head only 16 meters high, in preference to three neighboring chimneys from 25 to 40 m. Part of the electric current went down the winding shaft, which is tubbed with cast-iron rings and contains the pipes from the underground pumping engine; and at the level of 210 m. it caused an explosion, without serious consequences, in the pumping engine-house, after which it became dispersed in the pump, at a depth of 400 m. The other portion of the current, which remained on the surface, passed along the wires for the electric bells and telephones, breaking and burning these appliances, and also throwing down the underground manager, who was near the mouth of the shaft, as well as four men engaged on the screens.—Ex.

MAGNETISM.

GALVANOMETERS AND MAGNETIC DIP.

Mr. A. P. Trotter, the Cape Government electrician, writing to "Nature" from Cape Town on November 9th, says: "That while the variation of magnetic dip in Europe (from about 71 degrees in Aberdeen to 58 degrees in

Rome) probably gives little, if any, trouble to users of compasses and portable horizontal galvanometers with pivoted needles, the dip of about 58 degrees to the south at the Cape is sufficient to disturb seriously such instruments. I have seen several galvanometers which were useless until re-adjusted: these, having been sent out by makers of high reputation, were thought to have received damage on the voyage. I learn that it is a matter of routine in the Post Office to correct all new instruments for dip. Small pocket compasses are not appreciably affected, because the center of gravity of the needle is generally well below the point of support, and prismatic compasses escape, probably, on account of the weight of the card. Instrument makers could easily arrange a small magnetic field in their testing rooms, with a dip to the south of about 60 degrees, in which to adjust instruments intended for the Cape or Australia."

THE MAGNETIC SUSCEPTIBILITY OF IRON.

Except perhaps by experts in electricity, it is not commonly known how the magnetic quality of cast iron is affected by its mixture with certain other metals, and the short article on this subject which appeared in the "Western Electrician," of October 8th, may serve to supply information that is not usually found in the ordinary text-books. Mr. Force Bain says that when there is manganese in cast iron to the extent of 12 per cent., it cannot be magnetized with the most powerful currents or electro-magnets. The molecular rigidity, magnetic reluctance, magnetic inertia, coercive force or whatever you may choose to call it, of such iron, is too great to be overcome by ampere-turns, and hence the ampere-turn theory would not apply to a core made of iron of this quality any better than it would to a core of brass. Similar results follow, but to a smaller degree, when iron contains carbon, phosphorous, sulphur, etc., to exceed a certain small limit. The slightest trace of antimony will entirely destroy the magnetic qualities of iron which contains it. All iron of commerce contains some of these impurities to some extent. It does not run evenly in the same brand and there are no two brands that contain the same combination. The great variation in the magnetic susceptibility of iron accounts for a correspondingly great variation in the capacity of dynamos and motors of the same type and size. Every constructor of such machines has noticed the wide difference in the speed, voltage, etc., of dynamos of the same type, each having the same number of ampere-turns, but one having from 10 to 25 per cent. greater capacity than the other.—Ex.

PRODUCTS OF THE ELECTRIC FURNACE.

NITRIDE OF CALCIUM.*

A new body, a nitride of calcium, has just been announced by Mr. Henry Moissan, the eminent French chemist. This body is formed by gently heating metallic calcium in an atmosphere of nitrogen, when a combination between the two takes place. At a dark-red heat the reaction becomes violent, raising the whole mass to incandescence. Mr. Moissan finds that the yellow color usually associated with metallic calcium is due to a surface coating of this nitride, the pure metal being quite white. The chemical composition of the new body appears to be $N_2 Ca_3$; its specific gravity is 2.63 at 62 deg. Fahr., and its melting point somewhere in the neighborhood of 2,500 deg. Fahr. Its most remarkable property appears to consist in a reaction between the nitride and water, resulting in the production of ammonia quite analogous to the production of acetylene from calcium carbide. Mr. Moissan thinks that this reaction may ulti-

mately prove of considerable industrial importance, provided that the difficulties of cheaply preparing metallic calcium by means of the electric furnace are successfully surmounted.

*Trade Journal's Review.

ELECTRIC POWER FOR MILLS.

"It is the purpose of this paper to attempt to describe from the actual operation of two plants working under as nearly identical conditions as two manufacturing institutions can—the one operated by rope transmission, with heavy head shafts, sheaves, etc., and the other by means of motors distributed throughout the building. In one the actual operation of the steam engine is considered; in the other the current is supplied to the motor from the secondary switchboard or receiving station.

"Many have considered electric transmission in the light of a source of power, and we often hear comparisons on it with regard to power costs which are very misleading. Some have been imprudent enough to assert its economy for power purposes in connection with uneconomical water-power plants, as the means of making such developments commercially available; and several large plants for cotton mills have been developed on this line with such blindness as to their true commercial value from an economical standpoint that room is left for well-founded skepticism of their true value when compared with the many other more economical installations which might have been effected. Electricity's true position for power purposes is that of a transmitter; and, whatever the source of power, the point to be considered is its efficiency in connection with that source for transmitting purposes. Having settled that, our investigation then leads to its comparison with other well-known methods of transmission.

"For the purpose of this paper we will take up the investigation, by tabulated data, from the actual everyday operation of the plants. The period during which the conditions as regard the working load were approximately the same was between the 1st of April and the 25th of June, 1897, and we shall designate the two plants as No. 1 and No. 2. No. 1 is a steam-driven mill, having a steam plant geared up with ropes, heavy head gearing and large tapering shafts, as such plants are usually geared up in the best practice of to-day. The steam engine is an 800-horse power Corliss cross-compound, built in 1895, with cylinders twenty and forty by sixty inches stroke, and a rope wheel twenty-four feet pitch diameter, grooved for twenty-six one-and-three quarter-inch ropes, weighing thirty-five tons. This engine is being operated at an exceptionally low cost per horse-power for steam. There was in the mill during the period for which comparison of power is made 11,776 spindles and 720 looms; all the spindles and preparatory machinery were run full, but the looms did not average more than 682 per day. No. 2 is an electric-driven mill, which rents its current from a central station and distributes it through a continuous-reading wattmeter to four 150-horse-power inverted motors bolted to the ceiling in convenient locations for economical distribution of the power, and belted to the shafting. The mill has been in operation since the 1st of January, 1897. This mill had in operation during the period named above on an average 12,448 spindles, with preparatory machinery, and an average of 356 looms out of 500 in the mill. The weight of the shafting in the steam mill is approximately 136,000 pounds, and in the electric mill 122,000 pounds. * * * We find that the average in the steam mill is 535.71 horse-power for all purposes (this mill is only partly filled with machinery, and is using not quite two-thirds of its full power).

"From indicator cards taken we find that the power required to drive the shafting and belting on loose pulleys only is 228 horse-power; for the 720 looms and shafting only 349 horse-power, and for the whole mill 595 horse-power. Deducting the friction horse-power from the power required to drive the looms and shafting and dividing this result by the number of looms, we obtain the power required to drive one loom, which is 0.168 horse-power.

"Deducting the power required to drive the looms and shafting from the total power gives us 246 horse-power, which is the power required to drive the spindles and preparatory machinery. This amount divided into the number of spindles gives us sixty spindles per diem and 357 looms, as against the steam-mill machinery for this number of spindles.

"At the time the data given above were obtained, there were in operation in the mill 14,848 spindles, with the necessary preparatory machinery, and 720 looms.

"In the electric mill, owing to the lack of suitable instruments for testing the separate motors, we were unable to find the amount of power expended in friction, and consequently, having only the average power consumed, we can compare the mills by using the data obtained from the steam mill to bring the electric mill to the same basis. From the power chart we observe that on an average 418.2 horse-power per day were used in the electric-driven mill during the period above alluded to, namely, from the 1st of April to the 25th of June. During that period there were in operation on an average 12,448 spindles per diem and 357 looms, as against the steam mill operating 11,776 spindles and 682 looms.

"From the data obtained from the steam-driven mill we have the following distribution of power during the test for the steam-driven mill: Total power, 535; looms and shafting, 340; friction, 226; horse-power speed, 196; looms, 114; and for the electric-driven mill: Total power, 418; looms and shafting, 206; friction, 149; horse-power speed, 208; looms, 60. Hence the difference between 226 horse-power and 149 horse-power, which is seventy-seven horse-power, must be credited to the electric mill in its present condition.

"The following points from the foregoing can be stated as existing under the present conditions: The steam mill is operating under a disadvantage of an underloaded engine; the electric mill is operating under the disadvantage of driving more shafting per motor than it will when the full complement of machinery is installed.

"The steam mill requires more supplies in the shape of oil, sizing for ropes and other necessary incidentals due to the method of transmitting the power. The electric mill has cost nothing for its motors in six months of operation—not even the necessity of putting oil in the bearings, which was simply renewed once in that time as a precaution. The convenience of operating any section of the mill 'ad libitum,' without reference to the other sections, is an advantage which is felt in dollars and cents in plants using the electric transmission.

"The question which arises as to whether a generator directly connected to an economical type of engine to produce the power would consume the difference in the frictional horse-power is one which can only be answered from data from institutions having such plants. It is the author's opinion that this difference of power would not be exceeded, and he hopes subsequently to give more specific data from further experiment from the actual operation of these two plants under better conditions, viz., when both mills are completely filled with machinery and motors and engine run at their full load; also in obtaining the efficiency of direct-connected engines and generators.

"It must be borne in mind that, unlike a machine shop and other manufacturing establishments, where a large

amount of shafting is required to cover the ground and where intermittent power is used, a cotton mill drives in useful effect 95 per cent. of its shafting and uses actually in continuous operation almost the maximum power at all times."

SMALL ELECTRIC MOTOR USES.

Those who have the management of public electricity supply undertakings know full well the value of the electric motor as a factor in the reduction of the working costs.

But there are other and probably greater effects which the electric motor will produce with its more complete adoption in the near future—the writer refers to the beneficial effects upon the trade and productions of the country, and the hygienic and social effect on the community generally. In the first of these aspects it is possible to foresee the revival once more of a number of small and independent industries, such as existed, but under very different conditions, in former years. The possibilities are already being grasped by the artisan in France, Germany, Switzerland, and the United States. By the aid of the electric motor he begins to find that he can at least hold his own in competing with immense manufacturing concerns and combinations; he has a practically unlimited available power at his own door—which is a great boon to the artisan, and one which offers him an inducement to become his own master.

In a very small and limited degree the gas engine has already accomplished something in this direction, but its many imperfections, its cost, and the fact that it has never been available on the hire system, have kept it more or less in the background. The effect of hiring-out electric motors is thus mutually advantageous, and its natural tendency is to create fresh demands; in fact, the municipality which includes this scheme in its electric light undertaking offers a great inducement to the influx and establishment of new industries within its area.

With a more complete return to a multiplicity of industrial operations, there may also revive some neglected trades. From an hygienic point of view, the electric motor is far and away the best; it is cleanly in its working, gives off no deleterious gases, and displaces the boiler and smoky chimney. One of the ultimate results must also be the raising of the status of the working part of the community. By becoming his own master the artisan gains self-respect, becomes more resourceful, and therefore a more important member of society; and the more intelligent interest which he will display in his business must appreciably affect the general welfare of the country.—Alfred H. Gibbings in *Cassier's Magazine* for January.

ROENTGEN RAYS.

ROENTGEN RAYS AND COAL.

It was ascertained in the early days of the Roentgen rays that the rays pass without difficulty through the various modifications of carbon, but are stopped by silicates. In this manner we are able to distinguish between real diamonds and paste. Couriot, in "*Comptes Rendus*," has now observed that radiographs give a fair idea of the purity of a coal. That this should be so, in a certain sense, is not surprising; one might fear, however, that the test would be too delicate to be of any practical value. Experimenting with anthracite coal, lignite, peat, coke, briquettes, etc., Couriot found that the structure of the combustible, the presence of mineral impurities, and also the stratification could easily be recognized by the help of the Roentgen rays. Grains of pyrites are at once seen in coke. It is not necessary that the samples should be cut to regular shapes. Couriot did not take blocks of

more than 2 inch, however, which he exposed for about five minutes.—Ex.

CHEMICAL EFFECT OF CATHODE RAYS.

Some experiments on the chemical effect produced by the impact cathode rays, made by Professors Momson and Skinner, are thus reported by London "*Nature*": "Aluminum is rapidly evaporated from the cathode by an electric discharge in a highly exhausted vacuum tube in which air has been replaced by mercury vapor. The metal is condensed over the walls of the tube in the form of a bright mirror. An iron cathode gives a similar mirror in a mercury vapor discharge tube. When the aluminum coating is dissolved off the wall of the bulb by hydrochloric acid a gelatinous membrane remains, which gives the reactions of silica. When potassium vapor is used the glass opposite the aluminum cathode is roughened. In parts sheltered by screens from the discharge the glass is not attacked. In potassium vapor the aluminum cathode is not evaporated to any marked degree. Opposite the cathode, both in the mercury vapor and potassium vapor bulbs, a dark annular stain of the shape of the cathode is formed. This stain resists the action of strong hot hydrochloric acid, nitric acid, aqua regia, and potash solution. The action of hydrochloric acid removed it, apparently, by dissolving the glass. The tests indicate carbon, but the quantity of the stain is too small to make certain. The stain is also formed on screens of mica, quartz and calcite. Monatomic gases appear to permit the evaporation of aluminum, as Professor Callendar has observed its evaporation in an argon vacuum tube."—*Journal of the Franklin Institute*.

THE VELOCITY OF X-RAYS.

In the mechanical construction of Roentgen-ray tubes I can record a few advances, the most successful being the adoption of Professor Silvanus P. Thompson's suggestion of using for the anti-cathode a metal of high atomic weight. Osmium and iridium have been used with advantage, and osmium anti-cathode tubes are now a regular article of manufacture. As long ago as June, 1896, X-ray tubes with metallic uranium anti-cathodes were made in my own laboratory, and were found to work better than those with platinum. The difficulty of procuring metallic uranium prevented these experiments from being continued. Thorium anti-cathodes have also been tried.

Roentgen has drawn fresh attention to a fact very early observed by English experimenters—that of the non-homogeneity of the rays and the dependence of their penetrating power on the degree of vacuum; rays generated in high vacua have more penetrative power than when the vacuum is less high. These facts are familiar to all who have exhausted focus tubes on their own pumps. Roentgen suggests a convenient phraseology; he calls a low-vacuum tube, which does not emit the highly penetrating rays, a "soft" tube, and a tube in which the exhaustion has been pushed to an extreme degree, in which highly penetrating rays predominate, a "hard" tube. Using a "hard" tube, he took a photograph of a double-barrelled rifle, and showed not only the leaden bullets within the steel barrels, but even the wads and the charges.

Benoit has re-examined the alleged relation between density and opacity to the rays, and finds certain discrepancies. Thus, the opacity of equal thicknesses of palladium and platinum are nearly equal, whilst their densities and atomic weights are very different, those of palladium being about half those of platinum.

At the last meeting of the British Association visitors saw—at the McGill University—Professors Cox and Callendar's apparatus for measuring the velocity of Roentgen rays. They found it to be certainly greater than 200 kilometers per second. Majorana has made an inde-

pendent determination, and finds the velocity to be 600 kilometers per second, with an inferior limit certainly of not less than 150 kilometers per second. It may be remembered that J. J. Thomson has found for cathode rays a velocity of more than 10,000 kilometers per second, and it is extremely unlikely that the velocity of Roentgen rays will prove to be less.—Ex.

INSULATION.

MICA MINING IN INDIA.

This mineral, for which many useful applications are found in the arts, is mined in large quantities in Nellore, a maritime district of the Madras Presidency. The mineral is found near the surface, no subterraneous mining having yet been attempted. Mr. Robert W. Thompson, in the "Journal of the Society of Arts," tells us that mica occurs in masses of from 100 to 200 cubic feet, the method employed for detaching the stuff being blasting with gunpowder or dynamite. The cutting and sorting of the mica after it is won from the quarry is a very important part of the industry; the value depends not only on the sizes of the sheets, but also upon their freedom from flaws and their clearness and transparency. Slabs of clear mica have been obtained of a superficial area exceeding two square feet; such pieces are, however, rare. But pieces of no more than four square inches find a ready market. All clear mica is cut into rectangular pieces of certain sizes. The clippings, or waste, have hitherto been thrown aside as useless; but inquiries have recently been made for this waste, as the mineral is said to be useful as a lubricant when powdered. New uses are continually being found for the mineral. A patent has recently been taken out in India for a composition, in which it is the principal ingredient, for the covering of boilers, steam pipes, and the like, for it is an excellent non-conductor of heat. A cartridge has also been invented in which, instead of paper or metal for the wrapping, mica is used, the advantages of the material for this purpose being manifold. It is not easy to ascertain the actual cost of getting the material. That it is a very paying industry is clear from the eagerness with which both Europeans and natives are taking up land for mining.—Ex.

ELECTRICAL MACHINERY FOR GREAT BRITAIN.

The Westinghouse Electric and Manufacturing Company is crowded with British orders for street railway motors. There are 262 motors and eight generators to be turned out with all possible speed.

An abstract of the contracts on hand is as follows: For the Hull Tramway Company, 92 electric railway motors, to equip 45 cars and one track sweeper; for the Halifax Tramway Corporation, 12 motors to equip six cars; for the Bradford Tramway Corporation, 48 motors to equip 24 cars; for the municipality of Norwich, which has control of the tramways in that city, 80 motors to equip 40 electric cars, and four electric generators to be installed in the power house of the Norwich Tramway Corporation to generate the electric current for the operation of the line. For the City of Coventry, the greatest bicycle headquarters in all Great Britain, 20 motors have been ordered to equip 10 cars, and the order has been augmented by a call for two power generators. The well-known seaport of Plymouth has called for 10 motors and two power generators for operation of local electric railways.—Ex.

ELECTRIC RAILWAYS.

ELECTRIC RAILWAYS IN THE UNITED STATES.

To what extent electric railways have been developed in the United States, where, admittedly, they have pros-

pered in a manner unparalleled elsewhere, is shown in a short chapter of statistics given in the annual report of 1897 of the United States Commissioner of Patents. The first electric street railway in the United States was put in operation only a little more than ten years ago. In 1880, of the 2,050 road miles of street railway in the country nearly all employed animal power. Electric power had not yet come into use, but a few miles of lines were operated by steam and by cable. The total number of persons then employed on American street railways was a few hundred short of 12,000. Ten years later, in 1890, the United States Census gave the number of street railway employees as 37,434, and at the close of that year the total mileage of street railways all over the country was given as 8,123 track miles, on 5,661 of which horses were used, while the remaining 2,462 miles were worked mainly by electric and cable power. The capital invested in these roads was \$211,277,793, and 71,000 persons were employed on them. In 1894 the total mileage was 12,527, of which 7,470 was electric. The capital invested was \$648,330,755, of which \$423,493,219 were invested in electric railways. One hundred and ten thousand persons were employed on street railways in that year. In 1896 the mileage had increased to 14,470, of which 12,133 miles were electric. The capital invested was \$784,813,781, and the number of persons employed was not less than 140,000. The total mileage of electric railways in the United States up to October of 1897 was 13,765 miles, out of a total mileage of 15,718, and of these but 947 miles were horse car lines. The total capital invested was \$846,131,691, and the number of employees may be safely estimated at not less than 166,000.—Cassier's Magazine for January.

MISCELLANEOUS.

COST OF COPPER FOR TRANSMISSION CIRCUITS.

In a paper recently read by Mr. Chas. F. Scott, electrical engineer of the Westinghouse Electric Manufacturing Company, and embodied in a paper on "Electricity in Paper Making," read before the American Paper and Pulp Association, gave his conclusions as to the efficiency of electrical apparatus in the following words: "The full load efficiency of generators, both of direct current and alternating current, varies with the size and type, but for machines of 100 horse power and over the variation may be from 90 or 91 per cent. to 95 or 96 per cent. The efficiency of alternating current transformers, in the same way, may be said to vary from 96 or 97 per cent. in sizes less than 100 horse power and 97 to 98 per cent. in larger sizes. The efficiency of motors, both for direct and alternating current, varies from 80 or 85 per cent. to 90 per cent., in sizes from 5 to 100 horse power, and is 90 per cent. to 96 per cent. for larger sizes. Efficiency of transmission lines and distributing circuits depends upon the E. M. F., the amount of copper and upon the cost.

"The approximate efficiency of a transmission plant will therefore be between limits about as follows:

Generators	90 to 96 per cent.
Raising transformers	95 " 98 " "
Transmission line	90 " 95 " "
Lowering transformers	96 " 98 " "
Local wiring	97 " 99 " "
Motors	85 " 96 " "

Efficiency of plant..... 61 to 83 per cent.

"In local distribution from low voltage generators the losses in raising and lowering transformers are, of course, eliminated, and the range of efficiency becomes 66 per cent. to 86 per cent."

THE CLOCK OF THE FUTURE.

The New York Standard Company has succeeded in perfecting an electrical clock movement which overcomes all clock difficulties hitherto existing. The ordinary dry battery furnishes the motive power for the clocks and is concealed within the clock case. The movement runs equally as well with weak as with strong cells, automatically compensating for fluctuations in strength of current. The clocks are regulated in the ordinary manner by raising or lowering the pendulums to increase or decrease rate. Because of the ingenious and original method by which the power is applied in these clocks more nearly accurate time is obtained than is possible with any other movement. The best makers of mechanical clocks consider that a variation of a second a day is very close running, but clocks installed in this city by the New York Standard Watch Company have shown a variation of only four seconds after a run of thirty-four days. These clocks are the only ones that have ever given satisfaction in the Weather Bureau, New York City, oscillations of the tower in which it is situated having heretofore interfered with the running of the clocks placed in the same. One of the No. 10 has been running in the highest room of the tower for six months and given perfect satisfaction. At the end of one run of sixty-eight days the variation was only sixteen seconds. The movement consists of an electromagnet and armature so arranged as to give occasional impulses to the pendulum whenever an automatic switch closes the battery circuit. These impulses do not occur at fixed intervals, but their frequency varies with variations in the strength of the current. As the battery weakens the impulses occur more frequently, automatically compensating for fluctuations and strength of current in obtaining the greatest economy in the use of the battery. The pendulum, for the most part, is acted upon only by the force of gravity. Motion is imparted from the pendulum direct to the going train by means of a pawl of the simplest order. The electric clock, as perfected by the New York Standard Watch Company, seems to be without doubt the "clock of the future" and bound to supersede the winding clock as the stem winder has replaced the key winder. For further information address the New York Standard Watch Company, 11 John street, New York City.

BUSINESS NEWS.

NEW INCORPORATIONS.

Columbia, Cal.—Tuolumne County Water and Electric Power Company has been incorporated by J. W. Ellis, William Mansfield, Thomas Conlin and others to furnish water and electric power and light. Capital stock \$143,000.

Albany, N. Y.—The Manhattan Lighting Company, of New York, has been incorporated by Henry D. Brenner and others. Capital stock \$250,000.

Big Rapids, Mich.—W. E. Douley Electric Light and Power Company, incorporated by W. E. Douley, J. S. Douley, D. M. Martindale, J. W. Morton and W. I. Trott, to supply electricity for light, heat and power. Capital stock \$40,000.

Swedesboro, N. J.—Swedesboro Light, Heat and Power Co., has been incorporated by Charles D. Lippincott, Henry M. Mitchell, Thomas B. Turner, John C. Rulon, Benjamin F. Lawrence and James J. Davidson. Capital stock \$25,000.

Peoria, Ill.—Perry Electric Company, incorporated by N. U. Perry, R. E. Seymour and D. R. Chapman; electrical signal telephone. Capital stock \$2,500.

New York, N. Y.—Wm. Porter's Son Company has been incorporated by Annie M. Porter, W. H. Porter and N. F. Porter to make fixtures for burning oil, gas and electricity. Capital stock \$100,000.

POSSIBLE INSTALLATIONS.

Somerville, Tenn.—T. B. Yancey, Mayor, may be addressed concerning construction of electric light plant.

Pierre, S. D.—The new city electric light plant is now in course of construction.

West Concord, Minn.—E. W. Vanorman will shortly establish an electric light plant.

Lonaconing, Md.—The Lonaconing Electric Light and Power Co. will improve its electric light plant.

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ELECTRIC RAILWAYS.

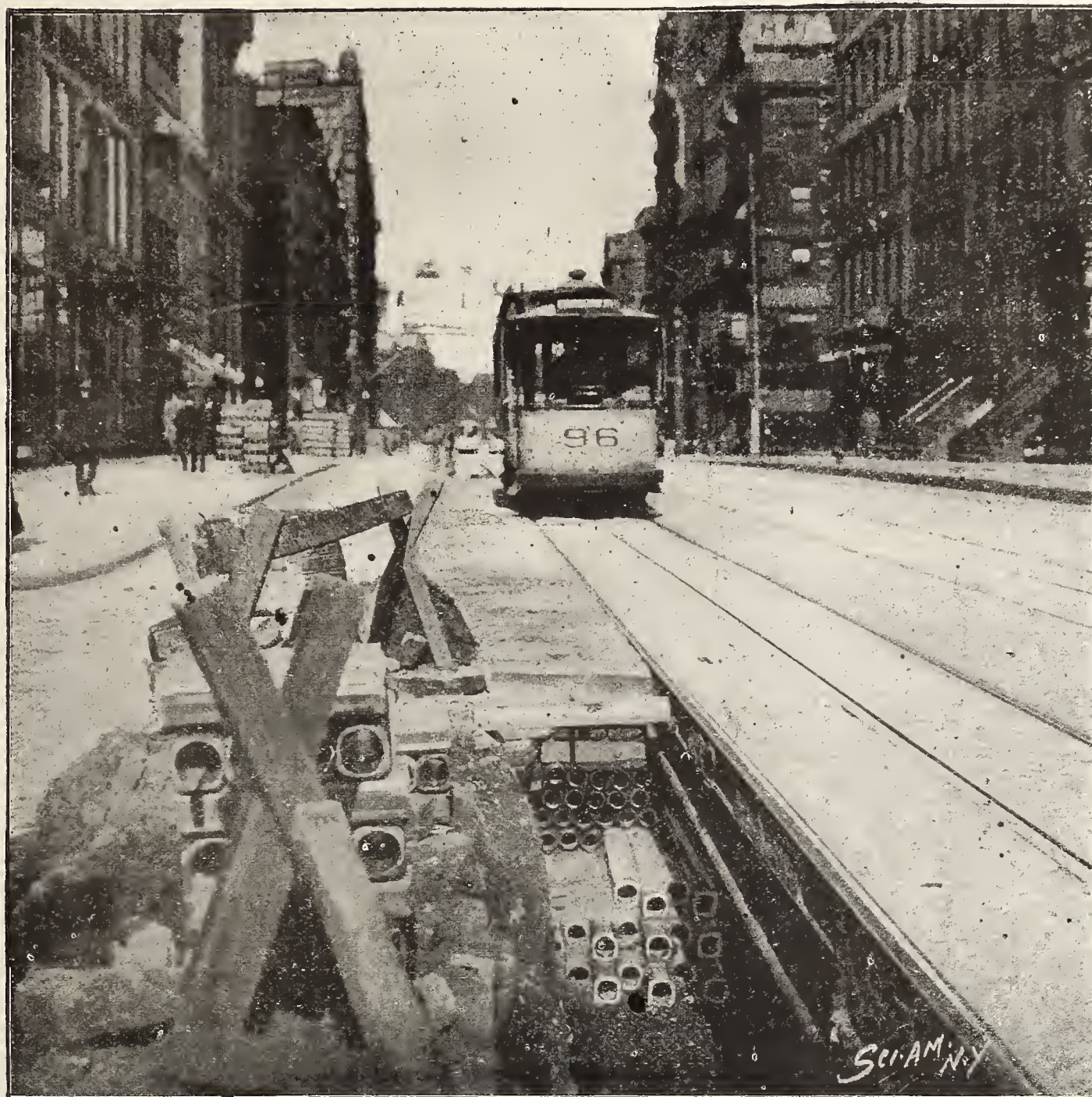


Fig. 1. Laying Ducts for Electrical Equipment of Broadway Cable Road.

(Courtesy of the "Scientific American.")

EQUIPMENT OF THE BROADWAY CABLE LINE WITH ELECTRICITY.

In recent issues the "Scientific American" has described at considerable length the important changes which are being made in the great system of surface roads owned and operated by the Metropolitan Street Railway Co. These changes include the construction of four important north and south lines of railway on the underground trolley system on Second, Fourth, Sixth and Eighth avenues, with connecting cross lines at Fifty-ninth and Canal streets, the changing of the Broadway and Lexington avenue lines from the cable to the underground trolley system, and the equipment of a crosstown line from the Hudson to the East River with compressed air motors. When the work which the company has now in hand is completed, 90 miles out of the total of 228½ miles owned by the

company will be mechanically operated. In the course of time it is intended to apply electric traction to the whole system, with the exception of some crosstown roads. If the use of the compressed air motor on the Twenty-third street line shows good results, it will be adopted on other crosstown lines.

The electric roads are entirely new construction, the old horse-car tracks having been removed in toto to make way for the cast-iron yokes and massive 107-pound rails which are the standard construction for all the new electric roads. On the Broadway road, on the other hand, the whole of the original track construction is available, and the changes are confined to laying of the cable ducts and bolting the conductor rails to the lower flanges of the slot rails within the conduit.

The ducts are laid in a trench which is excavated at the side of the tracks and slightly under them, as shown in the accompanying illustration, Fig. 1. Two kinds of duct are used, one consisted of riveted sheet iron pipe about four inches in diameter, lined internally with cement, forming the top layer of twenty pipes, the other being made of terra cotta in short lengths of about two feet.

The object of these numerous ducts is to carry independent conductors to different sections of the road, providing current, in case of accident to one section, to all the others, reducing to a minimum the possibility of delay on long stretches of road at a time.

The terra cotta ducts are preferred for the high tension cur-

cup, provided with lugs by which it is bolted to the slot rails. Within this cup is another of porcelain, which is held firmly within the cast iron cup by cement. The porcelain cup holds a 1½-inch wrought-iron shank, to which the conductor T-rail is bolted.

To enable the conductor rails and their supports to be put in place, two handhole boxes are being placed, one on each side of the slot, at every fifteen feet of the Broadway track. The conductor rails will be in thirty-foot lengths, so that it will be possible to slide them into the conduit at the handholes. They will be supported at the ends and at the middle. After the insulators and conductors have been passed in through the handholes and bolted up and the wiring to the cables in the ducts

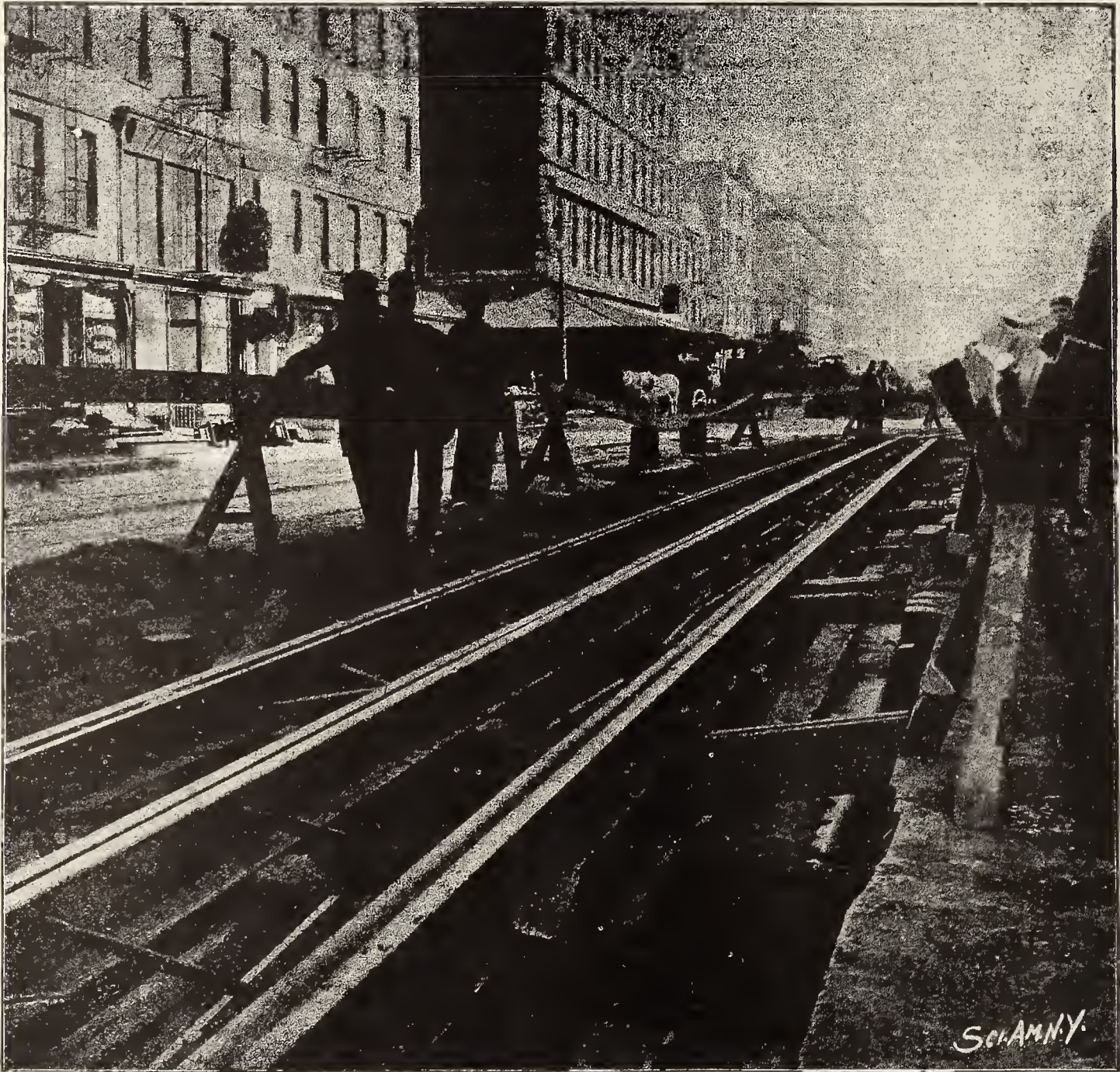


Fig. 2. Construction of Underground Trolley Road on Canal Street, New York City.

(Courtesy of the "Scientific American.")

rent cables. In laying the ducts, the bottom of the trench is leveled and covered with from four to six inches of concrete. The ducts are then arranged symmetrically in layers, and cement grout is run in between them to fill up the voids and bind the whole mass together. The sides and top are also concreted in, thus insuring that the continuity of the several lines of duct shall be preserved unbroken. Piles of these ducts will be observed on the sidewalk to the left ready to be placed in position. This work of transformation is going on without the least interruption to the regular cable traffic.

The conductors consist of two lines of T-shaped rail weighing twenty-one pounds to the yard, which are suspended below the cable slot by means of insulators attached to the lower flanges of the slot rails. The insulator consists of a circular cast-iron

completed, the Broadway road will be ready for the electric cars, which will commence running early in 1899.

The present Broadway cars can be used by equipping them with motors, and replacing the present grip by an electric plow. It is probable, however, that new and larger cars of the type at work on the present electric roads of the company will be supplied for this, the most important artery of travel in New York City.

In the underground trolley system as now being installed the track rails play no part in the electric circuit. The current is conveyed to and from the motor by means of the plow, one side of the plow receiving the current from the feed conductor and the other side delivering it to the return conductor. The shank of the plow consists of three steel plates,

the outer plates being one-eighth inch and the inner plates three-sixteenth inch in thickness. The conductors, which are wrapped copper ribbons, are carried down through the plow to the contact shoes or wipers, connection being made between them by flexible cables. The shoes are of cast iron and measure four inches by one-half inch. They are kept in contact with the conductor rails by means of side steel springs, which keep the shoes eight inches apart when free and six inches apart when they are in contact with the conductor rails. It has been found that a pressure of about six pounds is sufficient to insure good electrical contact between shoes and conductors.

The engraving, Fig. 2, shows a portion of the new underground trolley road in course of construction in Canal street. Under the slot is seen the sheet iron drain tube and to the right another form of terra cotta ducts, each section having four tubes about six feet long. By comparing it with the view of the Broadway road it will be seen that the new track is considerably heavier. The rails, weighing 107 pounds to the yard, are not only the most massive used in any street railway, but they are several pounds heavier than the largest rails used on the steam railroads, where the most massive rails do not exceed 100 pounds to the yard. This is the weight of the rails on main line of the New York, New Haven & Hartford Railroad and on certain stretches of the New York Central and the Pennsylvania Railroads.

Current for the whole of the underground system, including the Broadway line, is eventually to be furnished from one great central station at Ninety-sixth street and the East River. It will have a capacity of 70,000 horsepower, or over four times that of any existing power station in this country. The plant will consist of 87 watertube boilers of 800 horsepower each; 11 cross-compound engines, each of 6,600 horsepower; and 11 direct connected three-phase alternating current generators. The current, at 6,000 volts, will be led to eight substations, conveniently located with reference to the various lines. Here it will be converted by static and rotary converters to a pressure of 550 volts, at which it will pass to the conductors.

TELEGRAPHING WITHOUT WIRES.

TESLA'S LATEST INVENTION.

C. D. Wood, in the "Yale Scientific Monthly."

For many years there was but one man to whom our country could look for its advancement in electricity. Thomas A. Edison was the undisputed leader, and his word was law in the world of applied electricity. In the past few years there has been another man to step to the front, and through his skill and persistent mastering of difficulties he has obtained a similar or even higher position in the world of science.

Nicola Tesla is not an American by birth, but as his name implies, was born in Austria. Thinking that an opening was in store for him in this country, he made it his home, and to it he has contributed the results of his discoveries. Tesla's career has been one of difficulty. On two different occasions his laboratory has been on fire, and several important models were destroyed, on which he was still working.

For the past year the young inventor has been studying the problem of conveying electric currents without visible conductors. He has proved the theory concerning the ability of waves of ether to carry electricity, and has brought it to a practical test by making luminous, without the aid of wire, cylinders suspended in the middle of a room. He now claims that it is possible, without the aid of other media than the earth and the atmosphere in a certain state to transmit large quantities of electricity an indefinite distance. The transmission of such currents for long distances would open up a field of electrical engineering the extent of which would be hard to conceive. It is well known that air, when enclosed in a vessel, can be so rarified as to destroy its insulating properties, and

become a fair conductor. If the so-called electrical pressure at a certain point is sufficient, and that point be elevated so as to obtain the proper rarefaction, the electrical energy at the point can be conveyed to an indefinite distance.

Tesla has invented a machine (if it may be called that) by which, without danger to the human body, he can produce an electrical pressure to the amount of 2,500,000 volts. As the conductivity of the air increases directly as the pressure, the more current produced, the greater is the efficiency of the air to carry the particular current.

Tesla's generating apparatus or transformer, as he calls it, consists of a secondary coil, built up as usual around an iron core and wound with a large number of convolutions. This coil is surrounded by another, having wire of heavier diameter, but wound with fewer convolutions. This comprises the primary or low-tension coil, and is electrically connected to the secondary, in order that there may be no difference of potential. The length of the secondary coil is now to be considered. That the greatest possible electrical pressure may be obtained, the length of coil should be equal to one-quarter of the wavelength of the electrical disturbance in the circuit.

The current in this case may be supposed to travel 182,000 miles per second; there a frequency of 925 per second would maintain 925 stationary waves; hence, each wave should be 200 miles long. Tesla proposes that his coil shall be 50 miles in length. The current coming from the terminal connected with the earth traverses the transformer, and is led by an ordinary conductor to an elevated station. This elevated terminal is generally a rounded surface suspended at a height which insures the rarefaction of the air necessary to conduct that particular current. If the potential is high enough and the surrounding conditions of the country favorable, the air will offer less resistance than an ordinary copper conductor. If there were mountains in the vicinity, the elevated terminals would have to be placed upon them, for a large portion of the electricity would otherwise escape to the higher ground.

Situated at an equal elevation at the receiving station, we have a terminal similar to the one just described, and connected with the receiving transformer. The machine resembles the first transformer, except that the coils are in a reversed position. The inner coil with the greater number of convolutions acts as a primary, and the low tension coil takes the part of the secondary. Another conductor completes the circuit by carrying the current to the earth. In the circuit of the transformer lamps, motors or any other machines for the utilization of current are placed. Such is the practical application of the new theory. These elevated terminals might be suspended from balloons, or placed upon high promontories, provided the elevation is sufficient.

This scheme of transmitting electricity appeals to the business man as well as to the scientist, for he can readily see what large incomes could be realized with comparatively moderate expense. If the Kings County Electric Power Company of Long Island, which is now the largest electrical concern in the United States, could utilize the power of Niagara by this new method, they could do away with their several power houses and cut down their expenses one-half. This invention has not been the product of a small amount of work, but the outcome of long series of experiments and careful study on the part of the inventor. Tesla is purely a man of science. His connection with Edison was severed because he did not believe in a scientific life for the money that was to be found therein. He believed in giving his inventions to the world with unrestricted freedom, differing from his older partner, who was the business man, as well as the inventor.

ELECTRIC LIGHT AND POWER APPLIANCES.

REPAIR SHOP PRACTICE.

Divided as it is into many departments the repair shop is called upon to improve and in many cases to completely rehabilitate a generator or motor turned in for renovation. Due credit has not always been given to those entrusted with such responsible work. The change of voltage required may involve a modification in the winding of both armature and field of so radical a nature

than eleven ohms it will not take ten amperes at one hundred and ten volts pressure.

In fitting together a wrought and a cast iron surface generally met with where the magnet core and keeper or magnet core and pole piece meet, care should be taken to see that their respective cross sections are correct at the point of contact. In the sketch the cores made of wrought iron are set into a cast iron keeper for the purpose of securing not only mechanical strength, but enough cast iron surface to allow the lines of force from the wrought iron to pass freely in without being throttled. The ratio that is safe to employ as far as the areas of contact are



Commutator Repair and General Machine Shop.

that virtually an entire redesign is necessary. Frequently those interested commercially in the running of shops for either general repairs or manufacturing purposes find themselves at a loss for the need of a few pointers. In field winding, for instance, one of the proofs that it is correct may be applied as follow: Divide the size of the wire in circular mils by one thousand. If the result gives the number of amperes the coil is going to carry the size of the wire is correct. To decide upon the proper resist-

concerned are one square inch of wrought iron to two square inches of cast iron. The lines of force per square inch in the wrought iron at one hundred thousand would mean two square inches of cast iron in contact, each carrying fifty thousand lines of force. In armature winding the two general divisions are lap and wave winding. Lap winding is generally met with on bi-polar armatures and the so-called multiple wound generators. A wave wound generator is supplied with less brushes than pole pieces,



Rewinding Department.

ance divide the difference of potential at the terminals of the coil by the current the coil will carry and the resistance is obtained, which should be equal to that of the length of wire chosen. For instance, ten thousand circular mils or a number ten wire, divided by one thousand gives ten amperes, the maximum current the coil will take, provided its resistance is correct. At one hundred and ten volts the resistance of the wire should be equal to one hundred and ten divided by ten or eleven ohms. If the length of wire used for the coil has ten thousand circular mils cross section, but is of a greater resistance

whereas a lap wound generator generally possesses as many brushes as pole pieces. Wave winding applies to the winding of an alternator. An armature of this description with pan cake coils is found to possess a winding, each coil of which is reversed with respect to the other, and none overlap. To double the electro motive force of a generator it is simply necessary to double the number of external wires on the armature and halve the cross section of the wire. To double the current the reverse is practical, provided the number of active inductors are reduced to one half.

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THE ELECTRIC LIGHTING OF PRIVATE RESIDENCES.

It is manifestly impossible to anticipate the system of electric lighting which will be used in private residences. To light one's home, not as a mere matter of experiment, but with the intention of making it an economical and convenient practice is a proposition inherently interesting. It is strange to realize the efforts that are being made by concerns manufacturing small gas, gasoline and acetylene plants, to impress the general public with the direct benefit in money and convenience of such installations. Electric lighting in private residences is to us as important a problem as the illumination of homes by the above mentioned material is to those representing such interests. Domestic electric light plants at this late hour should be as familiar a feature of kitchen-economy as the ice cream freezer or the gas stove. Strange to say, the interest taken by electrical engineers in this exceedingly broad and profitable enterprise is rather limited in its nature. In all probability the reason is due to the absence of a small motor, the construction of which would be so simple or at least so perfect that Bridget could be left in full charge of the apparatus. Electrical men believe that the public must be educated up to certain improvements, and learn how to use them, but this is a mistake. Engineers must be educated up to the demands of the general public and learn to accommodate them.

This would save us from tons of complicated and useless machinery, which is theoretically valuable and interesting, but in practice is found to be unreliable and a general nuisance. The three plans worthy of consideration for electric lighting in our homes are as follows: First, the use of electricity from the street circuit; second, the introduction of small electric light plants for individual lighting; third, the installation of a block system. The sale of staple articles encourages us in the idea that the sale of electricity by large central stations is in perfect harmony with modern practice. But it will only be profitable to the general masses when the price of such power will meet all criticisms and remain unaffected by it. In this respect, the price of staple articles, among which electricity will soon be considered, naturally sinks to a certain figure, generally allowed as correct and approved of by the public. In consequence of this it is but a question of time to wait until this fair price is established. On the other hand, the introduction of small electric light plants is practical and may prove to be profitable, provided the saving brought about by their use will cover the cost of two or three years' illumination otherwise obtained. Referring for a moment to the block system of electric lighting, a system in which a miniature central station is established in the yards of a city block and from which power may be obtained to light all the houses surrounding it, this system, let it be understood, possesses obvious advantages. It might be regarded as one of the outcomes of communism or merely as an effort on the part of bread winners composing a city block to co-operate for the purpose of lighting their homes in their own way and at their own expense. To illustrate, take a square block of city houses, numbering about fifty, let them average about ten lights apiece or a total of five hundred lights. A bill against each of \$100 a year for lighting would not be considered exorbitant. At this rate the annual receipts would be \$5,000. The cost of fuel and the expense of running the plant would amount to \$2,500. Allowing \$2,500 for the plant itself, and a little wiring, would mean a complete financial balance at the end of the year of cost of installation and running expenses against the cash receipts. The second year, allowing the expense of running to equal \$3,000, the cost per residence for electric lighting would average only \$60, for which sum ten lights could be run eight hours a day, every day in the year. A private plant would take longer to pay off, but it seems as though it were no more sensible to pay rent for the use of furniture or necessary articles of home use than to pay for either light or power in the home. A well-designed gas or kerosene oil engine, direct connected to a small generator of about two horsepower size, costing, say, \$300, would pay for itself in the course of two years, and be acceptable to 50 per cent. of the owners of private residences. To people of moderate means the proposition is certainly an interesting one, and of prime importance, if time and a slight degree of labor are freely given as the full equivalent of what may be thereby saved.

A GERMAN ELECTRIC HAULAGE PLANT.

At the Altenwald coal mine, in the Saar district, the water from an upper level is used for working a 24-H.P. Girard turbine, the horizontal shaft of which drives directly a shunt-wound dynamo which, with 480 revolutions per minute, gives out 13 kilowatts at a tension of 440 volts. The current is led to a cross-cut, where, at a distance of about 600 m. from the shaft, a 12-H.P. electro-motor drives, by spur gear, an endless-rope haulage plant on gradients varying from 2 degrees to 8 degrees, conveying from 250 to 300 tons for a distance of 1,200 m. This plant has given complete satisfaction from both a technical and economical standpoint.

MISCELLANEOUS SCIENCE.

STRAY CURRENTS.

SEASONING LUMBER BY ELECTRICITY.

A new process is announced for seasoning wood by electrical action. The timber to be treated is put into a quadrangular tank of liquid, immersed to rather more than half its depth, and an electric current applied through a metallic conductor, so arranged as to distribute it throughout the area, and it is stated that in a space of four minutes the sap begins to exude at the lower end of the wood; in six hours it is all extracted. The wood is then placed in another tank, from which a septic solution is forced into the pores by an electro-capillary method. If, says the "Builder," this process has successful results at a cost which will not be commercially prohibitory, it may prove of great importance.—Ex.

ELECTRICITY AT PORT HEYST.

Port Heyst is now rising at the mouth of the ship canal joining Bruges to the North Sea. It is, therefore, sometimes called the port of Bruges, but such names have not much to recommend them. A very general use is made of electric motors at the port. Two Willans engines of 250 horse power are coupled with two continuous current generators, which feed the various electric motors in the brick works, smithies and workshops. The conductors are aerial. The power is not always sufficient to deal with the huge beton blocks for the caissons, which are being moved with the help of two electric derrick cranes. The power installation is, therefore, being enlarged.—Ex.

STEEL FOR MAGNETS.

The results of tests of a large number of magnets made of self-hardening steel, now in common use for lathe tools, are given in the "American Journal of Science." The object of these tests was to search for a material for standard measuring magnets which would be as permanent as possible, and have a small temperature and induction coefficient. The experiments show that comparatively short seasoned magnets made of this steel have decidedly smaller induction coefficients than magnets of the same dimensions made of tool steel; the difference in the temperature coefficient is much less, but the advantage is still on the side of those made of self-hardening steel; the temperature and induction coefficients of long magnets of the two kinds of steel do not seem to be very different.—Ex.

AN ELECTRIC ICE MACHINE.

Mr. Thomas J. Fay suggests a system by which electric plants may supply the wants of users of refrigeration without adding the details of the ice business to troubles of their own. His proposition is, in brief, to supply electricity to small individual plants, such as those used by meat markets, in which the current would be utilized in an ice machine, of which the motive power would be electricity instead of steam. Mr. Fay has designed and experimented with several such machines, with results which he regards as satisfactory; and he gives figures to show the cost of ice production. He is of the opinion that sooner or later automatic electrical equipment will "drive out the cold effrontery of the peddlers of ice, whose pedigree may not stand a close inspection."—Ex.

ELECTRIC FLOOR-SCRUBBING MACHINE.

Electricity has been brought into the service of domestic economy for various duties, but it is something new to utilize it in the cleaning of floors. An American inventor has devised and constructed an electric floor scrubber, of which great things are said. It is claimed that this little machine can do this kind of work in one-fourth of the time usually required in manual labor, at a saving of 75 per cent. of the cost. It is designed for use in Govern-

ment, State and large office buildings, hotels, stations, hospitals, halls, etc. These machines are said to have been already in use in various buildings, in one instance doing work on eight floors in two and one-half hours, which previously required ten and one-half hours to perform by hand. The number of hands is not stated, however. For the scrubbing brushes, sandpaper blocks or blocks of stone may be substituted, and thus the machine may be used to dress down wood floors or mosaic.—Ex.

THE PRODUCTION OF COPPER IN JAPAN.

Very considerable is the copper production of Japan, there being at present seventy mines. During the fiscal year ending June 30 last, 35,000,000 catties, or about 500,000 centners, of copper, valued at 5,800,000 yen (about \$3,000,000), were mined. Since 1875 the copper production has increased almost ninefold. Most copper is sent to Hong Kong, then to China and to England, the total export amounting to 350,000 centners, i. e., five-sevenths of the whole production.—Ex.

TIPS ON TRADE JOURNALS.

THE TRADE JOURNAL FOR ADVERTISERS.

There is no species of journalism, says "Fame," more essentially modern or more a product of recent years, than the trade journal. Its development is really a matter, for the most part, of the last two or three decades, and while there is a considerable number of papers and periodicals in the trade line that show weakness of grasp, and that must yet make their foothold, those which have gained a foothold are among the most stable of journalistic properties.

That the trade journal is greatly appreciated by people for whom it caters goes without saying. There would not be so many attempts to start a weekly or a monthly for every trade or business if this were not so. Of course, the getting a trade journal established depends primarily upon its ability to help or interest its readers, and not less upon its ability to secure advertising.

It may possibly be an apt comparison if I say that an established trade journal has the same excess of value to its clients over other papers that a physician who is a specialist has over other physicians for his patients.

The advertiser in a trade journal is mainly one who offers some commodity or service to persons engaged in a particular trade. The circulation of the paper represents a class of people, every one of whom can be considered and addressed as a possible patron. That they are intelligent above the human average is certain, or they would not take a paper devoted to one topic. And that they are worth addressing is equally sure, for each one must be an interested reader of the trade advertisement addressed to the trade.

For the above reasons it is not, perhaps, an exaggeration to say that every 1,000 of circulation in a trade paper is worth to any advertiser in the trade concerned any 10,000 or more of circulation in a paper addressing the general public.

The truth is, in the trade paper the advertiser offering something special to the trade represented has his "game," so to speak, directly before him. Every shot he sends forth hits the exact mark. On this account it will not do to despise a trade journal whose circulation is only in the hundreds, since these hundreds are pretty sure to read the advertisements, and to read them for a more definite and practical purpose than curiosity.

It is not true, of course, that every reader of intelligence takes a trade paper, but it is sure that every reader of a trade paper is sure to take other journals, and this one fact goes to show the intellectual quality of the constituencies the trade journal represents.

It is the consideration of this fact that makes advertisers also—who are not of the trade—use the trade journal. Such a one as the "Northwestern Miller" or the

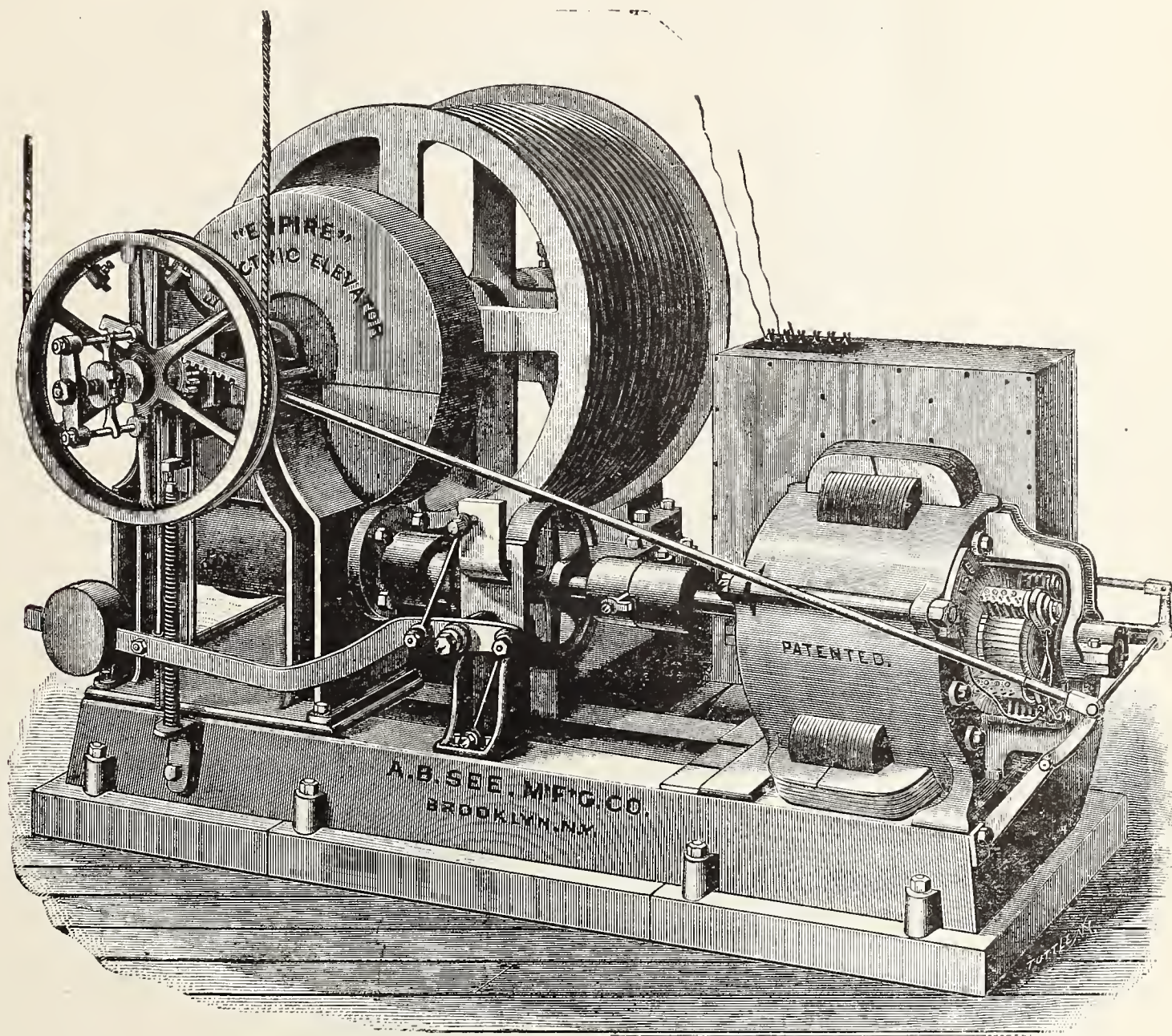
"Northwestern Lumberman," or the "Dry Goods Economist," or the "Iron Age," whose circulations are presumably large, and which have widely known names, can demand and get advertising not special to their direct line of thought and exertion. And such advertising ought to be justified; of course it is, or it could not be so offered and so generally secured.

DYNAMO DESIGN.

MOTOR CALCULATIONS.

The construction of a motor is largely governed by the nature of the work it is supposed to perform. A motor used in connection with a pump is called upon to stand a steady and comparatively uniform load. A motor designed to meet the variable load of an elevator must be prepared to resist sudden shocks, as it were, and an im-

contains seven and one half gallons. The weight of one gallon is eight and thirty-three hundredths pounds. Consequently a column of water pumped one foot vertically, having a cross section of one square inch, would weigh .434 pounds. From this we see that every additional foot in height to which the water is pumped will mean an additional pressure of .434 pounds. The horse power for a given number of gallons depends upon the number of feet to which it is to be lifted, the number of gallons pumped per minute and the weight of a gallon in pounds. To lift twenty-four thousand gallons six hundred and fifty feet per hour means the lifting of four hundred gallons per minute. Multiplying four hundred by six hundred and fifty feet and dividing by twenty-six hundred a constant will give one hundred horse power. This means an allowance of only thirty-four per cent. for the various losses that occur throughout the system. The efficiency in such a case would lie between 60 and 70 per cent. In



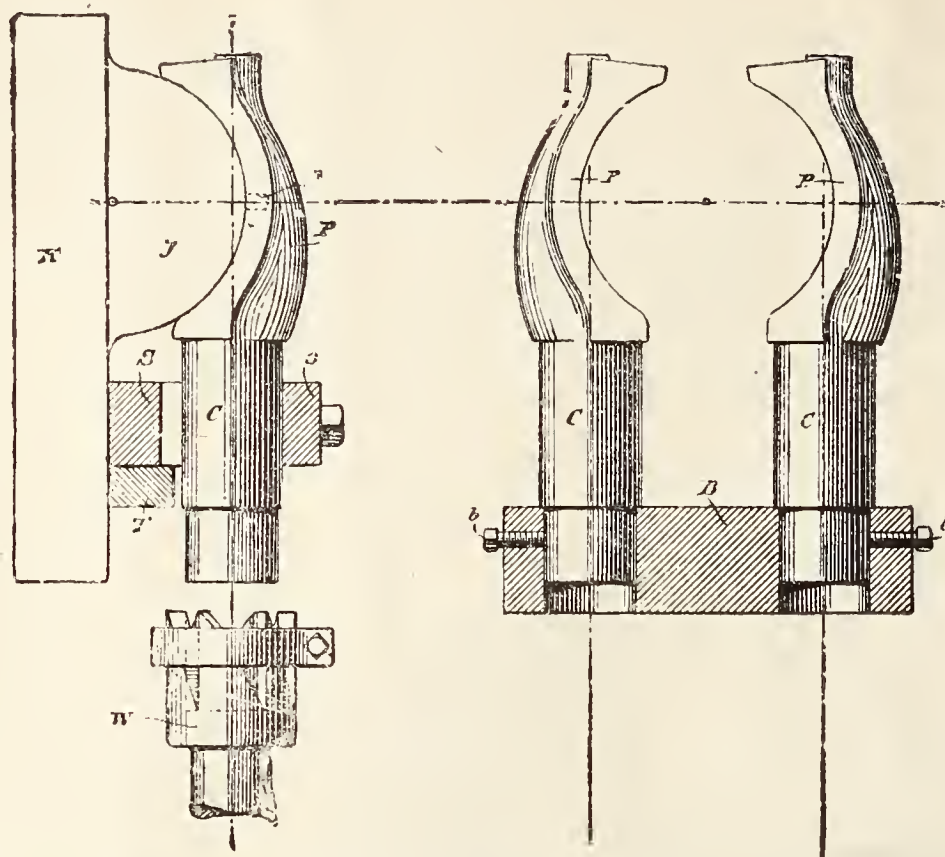
Electric Elevator, Showing Connection Between Hoisting Drum and Motor.

mense number of variations in load. The horse power required to lift an elevator is easily calculated by multiplying the weight of the elevator and its contents by its speed per minute. One thousand pounds moving upward at the rate of thirty-three feet a minute would call for one horse power without any consideration being taken of friction and losses by power transmission. The efficiency of an elevator system depends largely upon these losses, although the motor itself controls the general loss by virtue of its design. For pumping, the horse power consumption is not subject to such fluctuations as in the previous case. One cubic foot of water weighs one thousand ounces, or sixty-two and one-half pounds, and

elevator or hoisting work the efficiency of the motor may average seventy per cent., in which case this allowance will have to be made and an additional safety factor to provide against contingencies. Vertical traction differs from horizontal propulsion only in the matter of friction and possibly in relation to the unimpeded downward descent of the passenger or freight elevator. An electric pump used in hydraulic elevator work would consume power depending upon the gallons of water pumped per minute and the pressure in pounds per square inch. By multiplying these two together and dividing by eleven hundred and thirty the horse power required is obtained, allowing for friction, etc. To conclude, an elevator using

three hundred gallons of water per minute at one hundred pounds pressure would require a motor whose horse power equals three hundred times one hundred divided

are considered as suitable by various designers. The desirable features of the one practice may often be profitably sacrificed to secure the advantages of the other. The



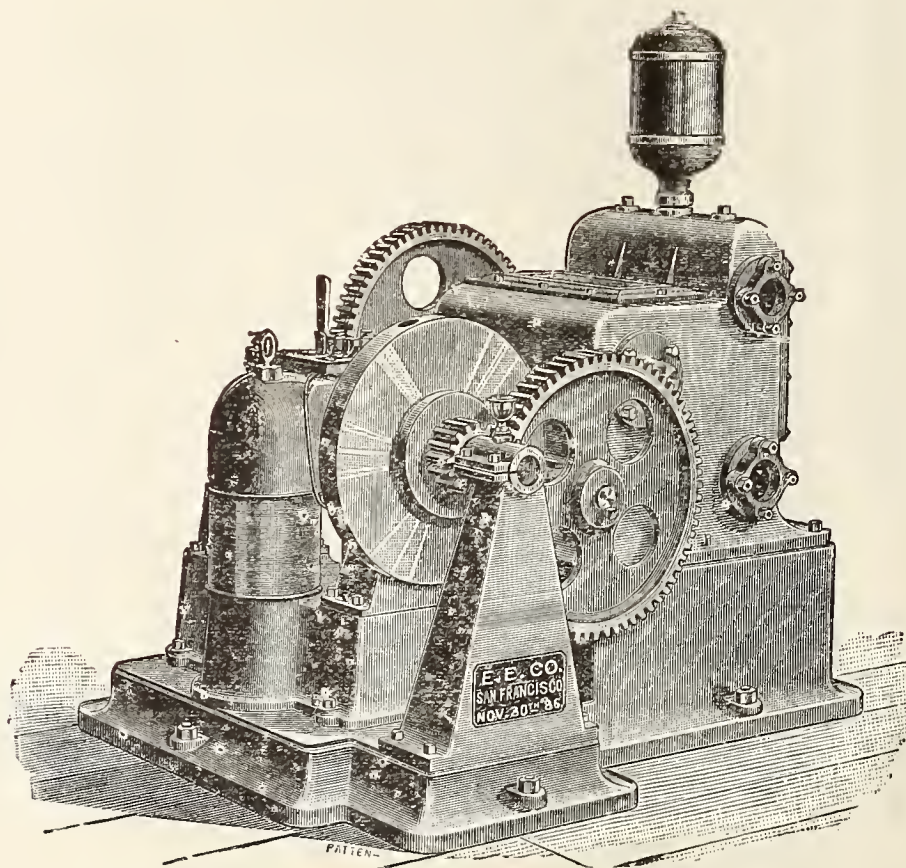
Method of Making Joint Between Wrought Iron Cores and Cast Iron Base.

by eleven hundred and thirty, or twenty-six and one-half horse power.

DYNAMO ARMATURES.

The best density to use in the magnetism of an arma-

strength of the induction, therefore, depends more on the conditions that are to be met in the design. If, says the "American Electrician," slow speed is desired above all else, there is no escape from high density. If, on the



A Compact Electric Pumping Plant.

ture is a question on which dynamo engineers seem to differ very widely. An examination of the various machines in practice discloses the fact that armature densities varying from 40,000 to 90,000 lines to the square inch

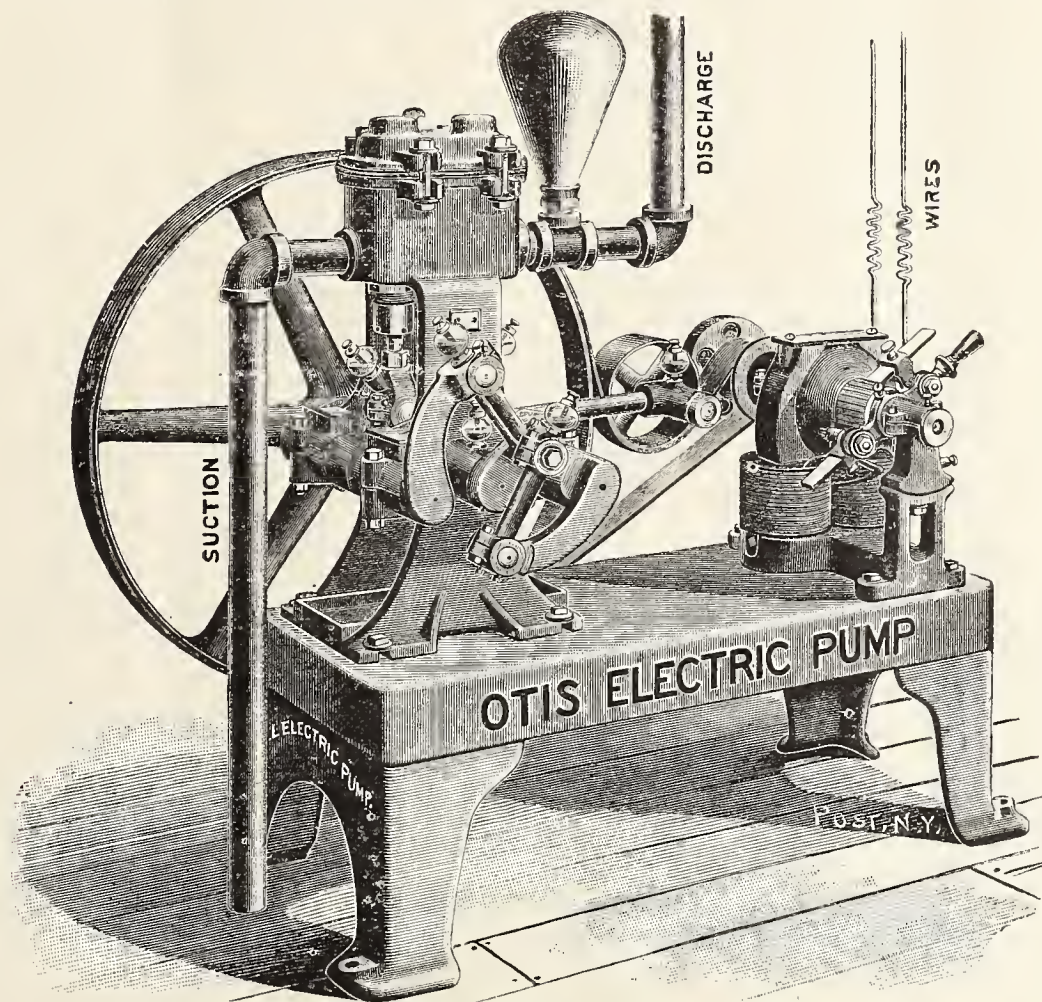
other hand, over load capacity is desired, high density is to be avoided. It is not to be inferred that a machine in which the armature is highly magnetized is of light weight, for as a usual thing little is gained in this direc-

tion by such a practice. The diminished area of the air gap will increase the reluctance and the leakage in sufficient measure to demand a field magnet and exciting coils of added weight. A ring armature which is inherently larger than a drum armature of equal output may work at a higher density, for it does not suffer as seriously by a diminished air gap. The necessity of carefully selecting the iron to be used in armatures to work at high densities is by no means imaginary. Iron, or rather steel—for all modern sheet iron is such—is frequently so highly susceptible to hysteresis losses that if incorporated into a core, it would heat dangerously when in operation from hysteresis alone. Indeed, of two armatures made of different iron but otherwise identical, one will often burn out and the other show itself capable of carrying heavy overloads. The difficulty, if not the impossibility, of uniformly procuring good iron is certainly a

served the action of electrical radiation on metal filings, free or agglomerated, placed in an insulator between two conductors forming a circuit made by a battery and a galvanometer. The filings, primitively insulated, or of very high electric resistance, become conductors when they are struck by an electric wave. This conductivity is destroyed by a blow, but reasserts itself when the filings are struck by a new wave.

M. Branly has given the name of radio-conductors to his tubes made of filings. This name suggests that their conductivity springs from the influence of electric radiation, produced by any source whatever. The sensitiveness of this transmitter is extremely great.

Prof. Popoff first used his own machine to register electrical waves produced by atmospheric disturbances; he then demonstrated that it could be practically employed in the navy for long-distance signals. England



Electric Pump, Showing Motor Belted to Pump.

temptation to lower the induction. The consensus of modern opinion seems to be that density is somewhat like speed; it may be increased above a certain limit to gain other advantages, but as a general rule the density cannot be increased over 50,000 lines to the square inch without serious sacrifice.—Ex.

WIRELESS TELEGRAPHY.

The following is a translation of an article by M. Ducrotet, explaining his theory, which has just furnished interesting practical results:

The starting point was the discovery by Henri Hertz, in 1889, of electric waves analogous to waves of light. A machine invented by him enabled one to perceive the diffusion of electric vibration at a short distance.

Prof. Popoff, a Russian savant, was on the point of applying this discovery to telegraphy in 1895, when he learned that M. Branly, a Frenchman, had already invented the tube seen in my machine and which is the essential point, as this puts in motion the electric currents, or, to use the technical term, the inducting currents.

M. Branly has not received the proper share of praise for his important invention. In 1890 he had already ob-

immediately commenced experiments with a machine based on the same principles and with which, it is said, messages have been sent between Bournemouth and the Isle of Wight.

Experiments have been made in Paris and quite recently at Brest, where Mr. Tissot has successfully communicated with a point 1,800 meters (5,905 feet) distant. I have covered a distance of 4 kilometers (2.48 miles), and the transmission was as clear, even through a fog, as between the Pantheon and my laboratory, rue Claude Bernard. I have reason to believe that still greater distances will be compassed. The chief difficulty will be to find two points at sufficient distance and at the same time high enough not to be hidden from one another. The success that has crowned our efforts is due to the improvements I have made in the receiving machine, and particularly in the Branly tube.

It can not be concluded from our experiments that Hertz telegraphy will take the place of ordinary electric telegraphy, but experiments already prove the value of this system for the exchange of signals between ships and the shore, for lighthouses and exploring service, and for communication in our colonies—African and Asiatic. In town, posts could be readily established by using win-

dows and towers on high buildings very far apart. The only objection would be that all machines favorably situated would receive the telegrams from one transmitter. This would render telegrams public property, unless a secret alphabet were adopted.

The receiving machine may be utilized for other purposes than communicating the current to a telegraphic machine; a row of incandescent lamps can be lighted, for example, or the fuse of a mine touched off. It is merely a question of sufficient force.

The experiments spoken of by M. Ducretet are now being carried on at his Paris laboratory. On the top of the building passersby may see a mast 20 meters (65 feet) high. A wire passes along the top and is connected below with an electric conductor, a Ruhmkorff coil, and an accumulating battery made after a special plan. The machine is set in motion by pressing on a handle. By manipulating this, a telegram can be sent as well as by an operator seated before his machine. It would seem that the message would stop when it reaches the end of the wire. This is not the case, for it is transmitted to a receiving machine 4 kilometers (2.48 miles) distant. To secure this transmission there must be no such obstacle as an iron wall or shaft between the two points. A simple wall does not interfere for a space of several hundred meters.

As soon as the transmitter is put in motion, the receiving machine—the ordinary Morse machine—begins to work automatically; the dispatch arrives as well as if a wire connected the two points. A bell rings to indicate the transmission of a message, but the paper rolls out automatically to receive the words printed by the Morse alphabet, and when the message is completed the paper ceases to roll.

The message is received through a garret window, from which hangs a wire. This wire communicates with the Morse machine through a box containing special machinery. As soon as the telegram starts this begins to tick, and an experienced telegrapher might spell out the telegram before it appears on the paper.

For the use of specialists and for laboratory experiments a small transmitter has been constructed which has no mast and has no wire running above. In the course of experiments, this little box has even been disconnected from the wire hanging from the window, and the transmitter started. The same ticking began, and the vibrations were plainly felt by taking it in the hand.

The box can be opened without danger and everything withdrawn. There will be found in it dry piles, small wire coils, and various apparatus known to electricians. Profane eyes see a little hammer that strikes on a tube when the current that transmits the telegram passes. The stroke of the hammer against the tube produces the ticking sound; and it is this tube, the essential part of the construction, that is the invention of M. Branly, a native of France. It is claimed in France that to this tube is due wireless telegraphy, both in this and other countries.

W. P. ATWELL,

Roubaix, Nov. 23, 1898.

Commercial Agent.

INSULATION.

INSULATING MATERIAL FROM FISH OFFAL.

According to a paragraph by E. Andreoli, in the "Electrician," the preparation of insulating materials from fish offal has already become an industry of importance in England, while nothing is done in France. A great many things are made of fiber or fish—pulleys, wheels, panels, objects of art, etc.—and impregnated with the oil extracted from fish at a very moderate expense; such objects are said to be superior to vulcanized fiber. The oil is ozonized, when it at once thickens considerably. Continued treatment with ozone improves the oil much in color, smell and in other respects. This treatment is, of

course, not inexpensive. But Andreoli himself has greatly increased the efficiency of ozonizers and has constructed apparatus which justify us in regarding ozone as an oxidizing agent in the technical sense.

ANGOLA RUBBER.

The Belgian Vice-Consul at Mossamedes reports that rubber exported from Benguela is in the form of elongated chestnuts, the natives giving to each piece the name of "metari," of which about forty go to a kilogramme. Almadina, which is sometimes exported in small quantities from the port of Mossamedes, is a substitute for caoutchouc, reaching the market in the shape of round balls, weighing about 100 grammes each. At present, rubber is the principal export product of Angola, and as it is submitted to an export duty of 3 per cent. when it is directed to a Portuguese port, and of 15 per cent. when to a foreign port, its export constitutes one of the most important resources of the Colonial Budget of Angola.

BUSINESS NEWS.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FOR WEEK ENDING DEC. 31, 1898, \$47,815.00.

New York, N. Y., Dec. 31, 1898.—The following exports of electrical material are from the port of New York for the week ending this date:

British East Indies.—Nine cases electrical material, \$210.

Berlin.—Two cases electrical machinery, \$200.

Brazil.—Thirty-three cases electrical machinery, \$1,748.

British Australia.—Forty-four cases electrical machinery, \$3,700.

Bremen.—One case electrical machinery, \$315.

British Guiana.—Eight packages electrical material, \$83.

British Possessions in Africa.—One case electrical material, \$60.

British West Indies.—Twenty-one packages electrical material, \$663.

Central America.—One hundred and eighty-nine packages electrical material, \$4,838.

Cuba.—Thirty-five cases electrical material, \$2,441.

Ecuador.—Forty-five packages electrical material, \$952.

French West Indies.—One package electrical material, \$18.

Genoa.—One case electrical material, \$130; two cases electrical material, \$33.

Hamburg.—Twenty-two cases electrical material, \$1,183; 1,224 gallons varnish, \$3,100; 99 cases electrical material, \$17,176.

Hayti.—Five packages electrical material, \$187.

Havre.—Five packages electrical vehicles, \$1,875.

Liverpool.—Fifty-seven packages electrical material, \$2,063.

London.—One case electrical instruments, \$550; 116 cases electrical machinery, \$3,800; 16 cases electrical material, \$612.

Manchester.—One case electrical machinery, \$300.

Marseilles.—Two cases electrical machinery, \$100.

Milan.—One case electrical material, \$20.

Peru.—Eighteen packages electrical material, \$341.

Santo Domingo.—Four packages electrical material, \$45.

Siam.—Eleven packages electrical material, \$574.

Venezuela.—Two hundred and seventy-eight packages electrical machinery, \$698.

TELEPHONE CALLS.

Colville, Wash.—Columbia and Northern Telephone and Telegraph Co. has been incorporated, with a capital stock of \$15,000.

Columbus, O.—Columbus Citizens' Telephone Co. has been incorporated by H. D. Critchfield, E. R. Sharp, J. B. Hanna, J. B. Hoge and others, to operate local telephone system. Capital stock, \$500,000.

Columbia, Mo.—The Columbia Telephone Co. has been incorporated by E. W. Stephens, J. A. Hudson, A. W. McAlester and others. Capital stock, \$5,000.

Mexico, Mo.—The Lafayette Telephone Co. has been incorporated by D. B. Moore, E. D. Graham and others to construct and operate telephone systems. Capital stock, \$12,500.

Florence, S. C.—The Florence & Allison Telephone Co. has been incorporated, with R. C. Commander president, and C. Poston secretary and treasurer. Capital stock, \$1,000.

Lexington, Tenn.—The Lexington Telephone Co. has been incorporated by John E. McCall, H. E. Graper, E. J. Timberlake and others. Capital stock, \$2,000.

Greencastle, Ind.—Putnam County Telephone Co. has been incorporated by J. Richardson, F. G. Gilman and C. C. Hurst. Capital stock, \$10,000.

Dillon, S. C.—The People's Telephone Co. has been incorporated by C. A. Woods, E. L. Moore and John Willcox.

Waco, Tex.—The Electrical Construction Co. has been incorporated by E. Botan, W. W. Seley, S. Sawyer, E. N. Stephenson, J. B. Earle and others, to construct, maintain and operate telephone lines. Capital stock, \$35,000.

POSSIBLE INSTALLATIONS.

Eau Claire, Wis.—The Chippewa Valley Electric Railway Co. has decided to put in a large power plant to operate its lines, and will also bid for the contract for city lighting.

Owenton, Ky.—Arnold & Riley contemplates the establishment of an electric light plant.

Lake Providence, La.—The Mayor may be addressed concerning the proposed issuance of \$7,500 in bonds to buy an electric lighting and water supply system and for other purposes.

Baltimore, Md.—The Tuxedo & Embla Park Water & Light Co. is arranging to award contracts soon for the construction of its proposed electric light and water plants.

NEW INCORPORATIONS.

Dover, Me.—Milo Electric Light and Power Co. has been organized, with Julian d'Este president and treasurer, for the purpose of heating and lighting the towns of Milo, Sebec and Brownville. Capital stock, \$10,000.

Ottawa, Can.—The Metropolitan Electric Co. has been incorporated with a capital stock of \$500,000.

Elizabeth City, N. C.—The Carolina New Light Co. has been organized by J. B. Griggs, W. T. Old, D. B. Bradford and others. Capital stock, \$25,000.

Columbus, O.—American District Telegraph Co. has been incorporated by H. D. Bennett, J. F. Miller, W. F. Bardell, G. W. Patterson and A. M. Schayer. Capital stock, \$50,000.

BUSINESS CHANGES.

Somerville, Mass.—Lemuel Mellett, electrician, has filed a petition in bankruptcy. Liabilities, \$6,215; assets, \$500.

STREET RAILWAY NEWS.

Hartford, Conn.—An electric line will probably be constructed between Enfield and Somers.

NEW YORK ITEMS.

THE WESTON ELECTRICAL INSTRUMENT CO., Newark, N. J., is well pleased with the 1899 outlook. They have now in course of construction a large addition to their already extensive works, in order to successfully meet the demand for their instruments.

H. C. BECK, president of the W. C. Vosburgh Manufacturing Co., Ltd., 269-281 State street, Brooklyn, the largest gas and electric fixture house in the country, finds the outlook for 1899 excellent, and his company is rushed in order to keep up with the orders being received.

F. C. ROSS, 255 Greenwich street, manufacturing electrician, finds business in a very prosperous condition, with bright prospects for next year.

THE GARVIN MACHINE CO., Spring and Varick streets, are the largest manufacturers of metal working machinery in the Eastern States, and carry in stock for immediate delivery all styles to meet the demands of the most careful and painstaking buyers. Their business has grown to such large proportions since their fire last year that they are making extensive preparations for a larger and increased business during the next year.

SCHIFF, JORDAN & CO., 232-234 Greenwich street, without doubt manufacture one of the best enclosed arc light carbons. The demand for their famous arc light carbons has trebled their business for one year, and they expect to quadruple the same during the next year. They found it advantageous and at the same time necessary to add a general supply line to their business some time ago, and are so well pleased with the success of the same that they are making preparations to increase the line during the coming year.

HATZEL & BUEHLER, 114 Fifth avenue, electrical engineers and contractors, are the pioneers in this particular field and are practically the only electrical engineering and contracting firm not offering any specialties or novelties. They are thus enabled to devote all their time and attention to the supervision of installations without being hampered by any outside ties to the detriment of the interest of their clients. Their prospects for 1899 are very bright.

MR. GEORGE L. WILEY, the Eastern manager of the Standard Underground Cable Co., Telephone Building, has lost none of the suavity of his manners and still possesses the same magnetic qualities which have heretofore attracted buyers. Judging by the way orders are flowing into his office, this quality seems to be on the increase, and we hope the New Year will bring Mr. Wiley all the prosperity wished for.

THE PARTRIDGE self lubricating carbon brush for motors has been greatly improved, and as a proof of this the Partridge Carbon Co. state that they cannot keep up with the demand for the same, and are preparing to increase the output for 1899.

DR. J. W. DE LERY, one of the popular men among the electrical trade, is receiving the congratulations of his many friends upon the great success with which his new company is meeting in the introduction of the new De Lery incandescent gas light. A call at the offices of the company, at 258 West Twenty-third street, will convince our readers of this.

A. H. PATTERSON, manager of the Phoenix Glass Co., 15 Murray street, is well satisfied with the past year's business, and is preparing to double the same during 1899.

"OKONITE," the most famous brand of rubber insulated wires and cables, and which was awarded a medal at the 1889 Paris exposition and the World's Fair, at Chicago, in 1893, for the best rubber insulation, is looking forward to the 1900 Paris exposition with great confidence in its ability to again carry off the palm. We wish it a "Happy New Year" and success in 1900.

A. L. BOGART CO., 123 Liberty street, has doubled its business during the last six months and expects to double its present business during 1899.

J. JONES & SON, 64 Cortlandt street, report a good paying business during 1898, and are looking forward to 1899 as another big interest paying year.

THE EDISON, JR., LAMP, under the management of Mr. C. F. Stilwell, has had a very prosperous year, and will no doubt shine brightly during the coming year.

THE STANDARD UNDERGROUND CABLE CO., Westinghouse Building, Pittsburg, Pa., are sending out to their friends and customers a combination foot rule and wire gauge, as a reminder that they are "on earth," and that they would appreciate their orders for their various kinds of wire. As a reminder, the above article is unique and we would advise our readers to write for one.

THE ABENDROTH & ROOT MANUFACTURING CO., 28 Cliff street, New York City, manufacturers of the famous Root boilers, state that they have nearly doubled their business during 1897 and 1898, and are looking forward to an equally large increase during 1899.

STEIN & LANGL 220-222 Centre street, experimental and model work, express themselves as well satisfied with the past year's business and state that the outlook for the coming year is very favorable.

CHARLES J. BOGUE, 215 Centre street, is greatly pleased with the success which his "American" enclosed are lamp has met with, and will keep the same well to the fore during '99.

"TUPPER" grate bars are being received with favor wherever introduced, and are living up to the high standard set for them by the W. W. Tupper & Co., 39-41 Cortlandt street.

THE EDISON DECORATIVE AND MINIA-TURE LAMP DEPARTMENT, of Harrison, N. J., has found the closing year a banner year for their well-known lamps, and predict a steadily increasing business for 1899.

THE NORTHERN ENGINEERING CO., Cortlandt street, is closing the year in a most satisfactory manner to themselves. They have received the Government contract for fitting out a complete steam plant for the electric light plant at the Brooklyn Navy Yard. A

large sum of money will be invested in this plant, and Messrs. Kroman & Hoffman are able to fill this order satisfactorily. The new year, therefore, looks very auspicious to them.

SCHMIDT & BRUECKNER, 207 Greenwich street, makers of fine telephones, are greatly pleased with their business, as the same has doubled itself during 1898, and they are therefore contemplating their removal to larger quarters during the coming year, in order to be able to meet the ever-increasing demand for their well-known goods.



WESTON STANDARD

PORTABLE DIRECT READING

VOLTMETERS AND WATTMETERS

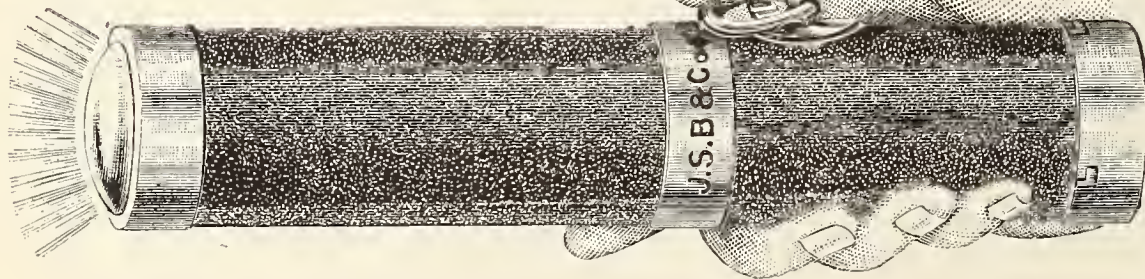
For Alternating and Direct Current Circuits.

The only standard portable instrument of the type deserving this name.

Write for Circulars and Price Lists 8 and 9.

WESTON ELECTRICAL INSTRUMENT CO.
114-120 WILLIAM STREET, NEWARK, N. J.

H. P. SAFETY POCKET LIGHT



AN EVER-READY ELECTRIC LIGHT

For Electricians, Engineers, Navigator, Machinists, Miners, Hunters, Physicians, Watchmen and Policemen, and for all purposes where a safe and handy flash light is desired. LIGHTS AND GOES OUT AT WILL. Cannot be blown out.

Gives from 6,000 to 8,000 lights before new battery is required. No wires to get out of order. No chemicals to spill; self contained. Can be carried into a cellar full of leaking gas, into an oil tank, alcohol and malt vats, or placed in a keg of powder without the slightest danger of explosion.

No.	Size.	Net Wgt.	Vts.	Complete by mail.
1	1 3/4 x 9 in. (pocket)	1 lb.	3 1/2	\$3.30
3	1 3/4 x 14 in. (large)	1 1/2 lb.	5	5.50

James S. Barron & Co.,

Manufacturers of and Wholesale Dealers in

General Electrical Supplies,

24-30 Hudson St.,
NEW YORK.

75c.

"VULCAN" STYLOGRAPHIC PEN.

75c.



"INDEPENDENT" FOUNTAIN PEN.



PRICE, WITH ENGRAVED HOLDER, \$2.00. SAME WITH COLD BANDS, \$2.50.

Fountain Pens licensed under Patents 260,134 and 311,554.

Send for our New Catalogue and Discounts.
AGENTS WANTED.

J. K. ULLRICH & CO., 27 Thames St., New York.

ELECTRICAL SPECIALTIES.

—MANUFACTURERS OF—

Stock Orders for Supply Houses, Dealers and Inventors.

STEIN & LANGLOS,

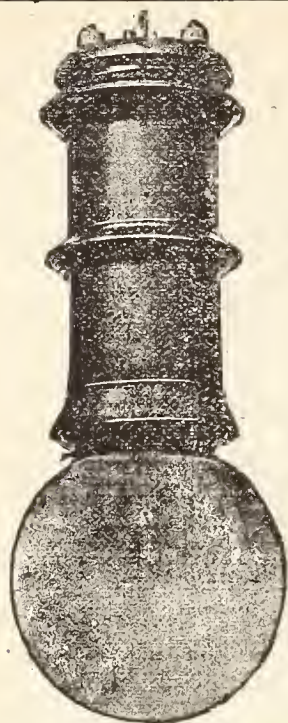
—MANUFACTURERS OF—

ELECTRICAL AND MECHANICAL SPECIALTIES,**220 and 222 Centre Street, New York.****TOOLS.****PRESS AND MONITOR WORK OF ALL KINDS.****DIES.**

VANCE ELECTRIC COMPANY**Construction Engineers and
General Electric Contractors.****Electric Lighting,****Electric Heating,****Electric Wiring,****Electric Bells,****Electric Telephones,****Power Transmission,****Marine Plants.**

Having recently fitted out thirteen of the UNITED STATES GOVERNMENT TRANSPORTS during the HISPANO-AMERICAN WAR with complete light, power and ventilating plants, we are fully prepared to do prompt work. Installations requiring dispatch and night work a specialty.

ELECTRICAL EXCHANGE BUILDING,**136 Liberty Street,****New York.**



American Enclosed Arc Lamp.

The latest, best and handsomest Long Life Arc Lamp, giving 150 hours' light before trimming the carbons or cleaning the globes. The inner globe will not blacken or discolor during the life of the carbons. The mechanism is so simple and compact that it will never get out of order.

Before closing your contracts for Enclosed Arc Lamps call and inspect this lamp. Fourth Avenue Trolley Cars pass our doors.

AUTOMATIC FOCUSING LAMPS,

3,000 to 10,000 C. P.; for Studio, Process Work, etc.

THEATRICAL SCENIC EFFECTS.

SEARCH LIGHTS AND PROJECTORS,

10 to 100 amperes.

ENGLISH NAVAL OR MANGIN MIRRORS.

CHAS. J. BOGUE, Manufacturer, 213-215 Centre St., N.Y.

TELEPHONE, 211 SPRING

CLASSIFIED LIST OF ADVERTISERS.

ADVERTISERS WILL FAVOR US BY ATTENDING TO THE PROPER CLASSIFICATION OF THEIR BUSINESS BY ADDRESSING THE ELECTRICAL AGE, BY POSTAL CARD. INDEX TO ADVERTISERS PAGE II.

Alternating Generators.
Bogue, C. J.
J. Jones & Son.
Ft. Wayne Electric Corporation.

Arc Lamps.
(See "Lamps.")

Armatures.
Bogue, C. J.
Stucky & Heck El. Mfg. Co., Ltd.

Ammeters and Voltmeters.
Weston Electrical Instrument Co.

Batteries, Primary.
Gordon Battery Co.
Prescott, F. M.

Batteries, Dry.
Himmer, V.

Batteries, Storage.
Electric Storage Battery Co.

Battery Material.
Gordon Battery Co.
J. Jones & Son.

Bells.
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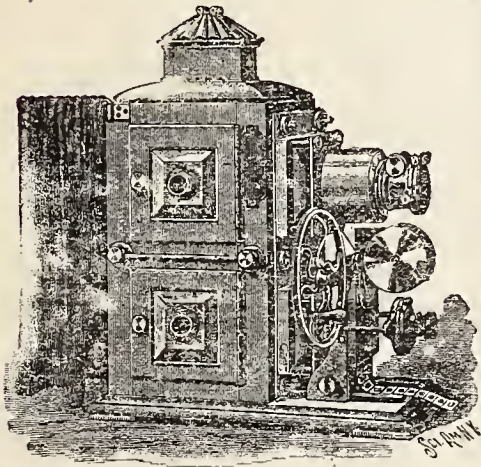
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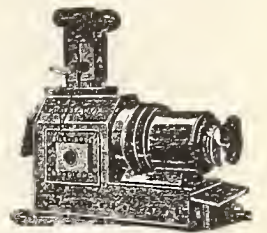
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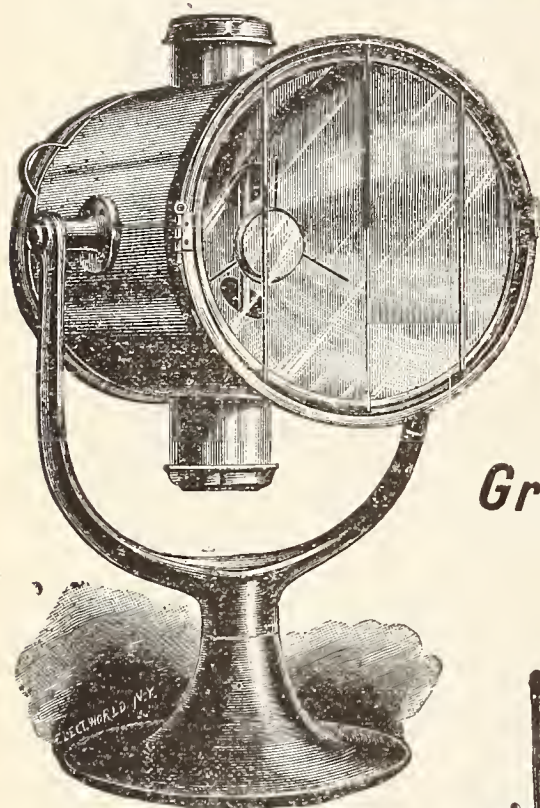
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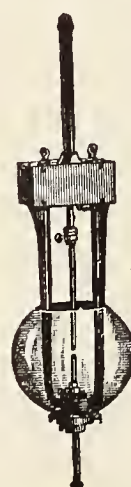
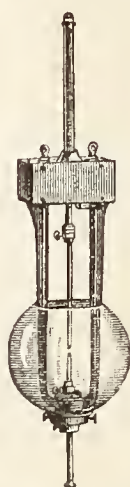
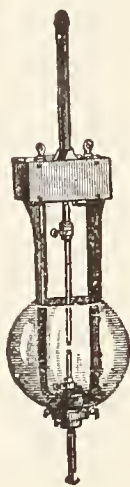
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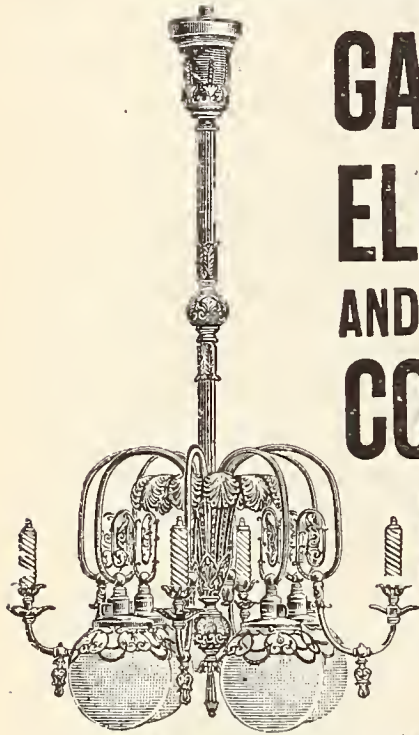
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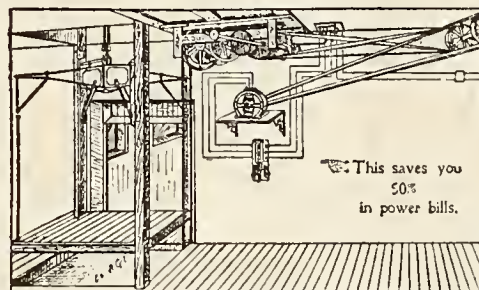
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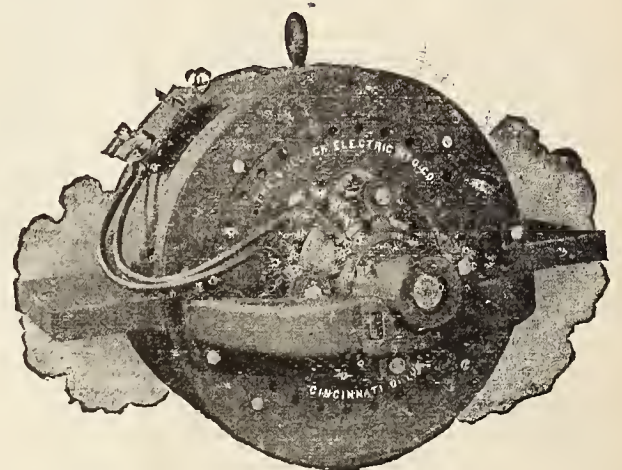
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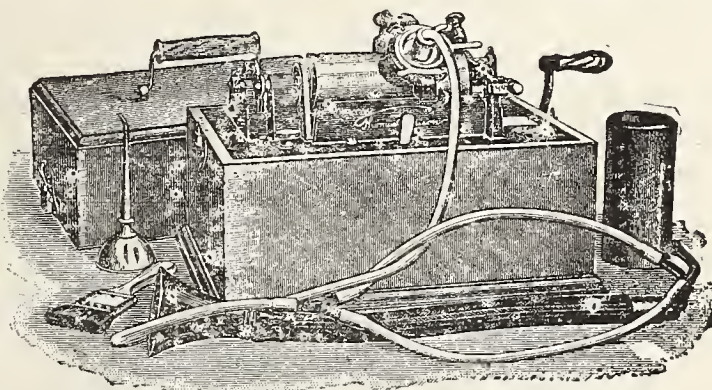
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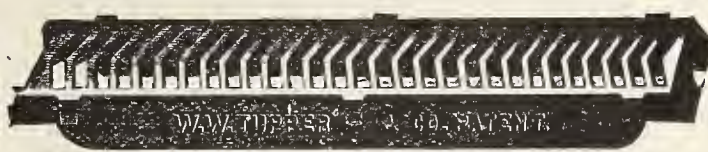
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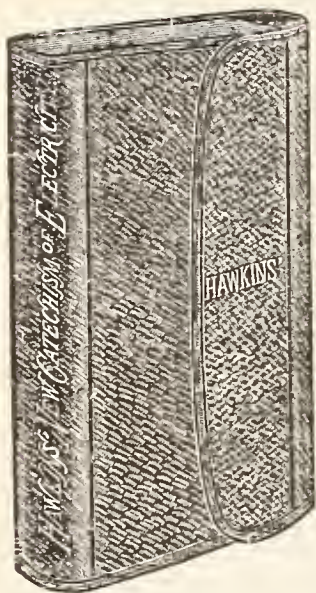
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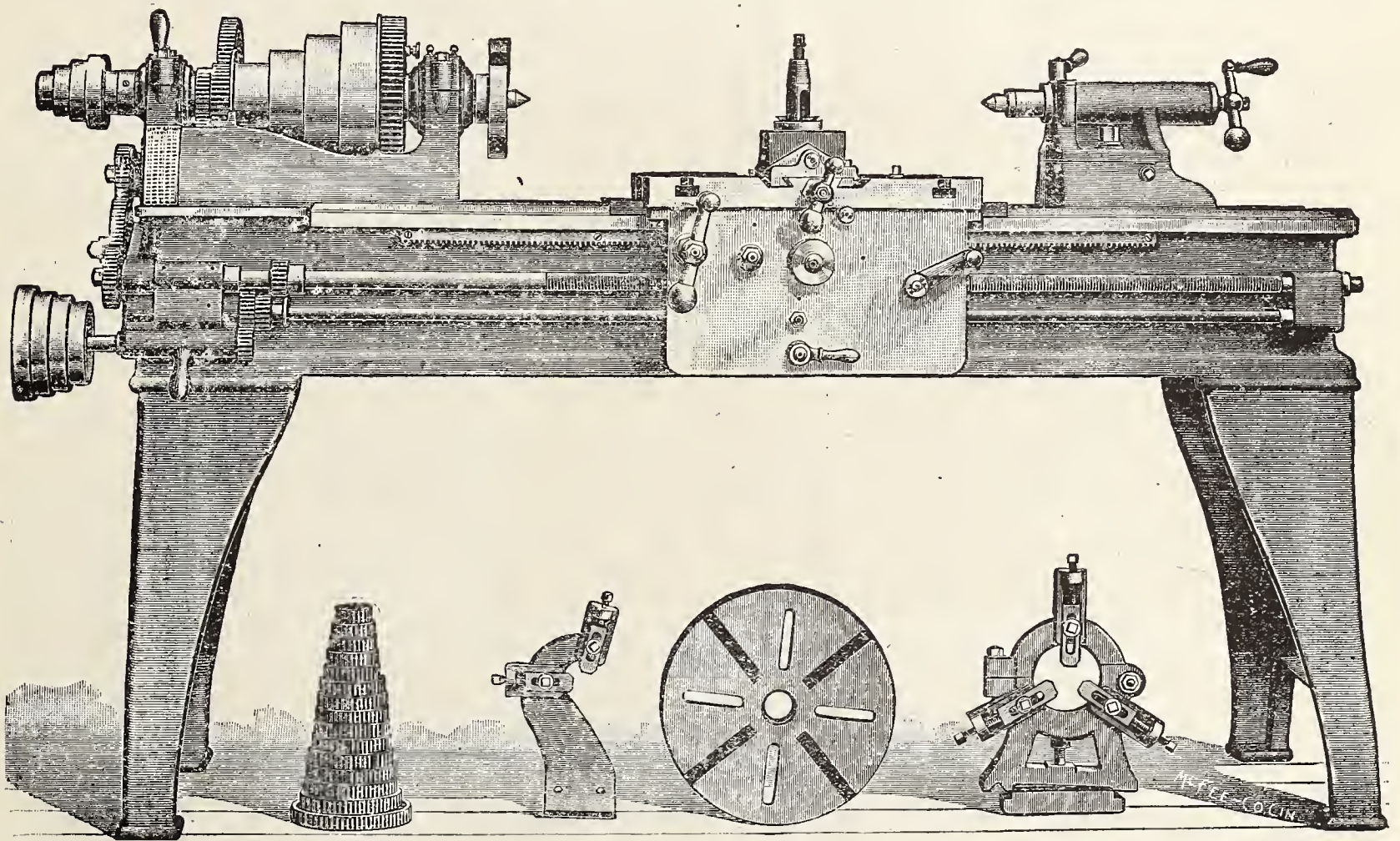
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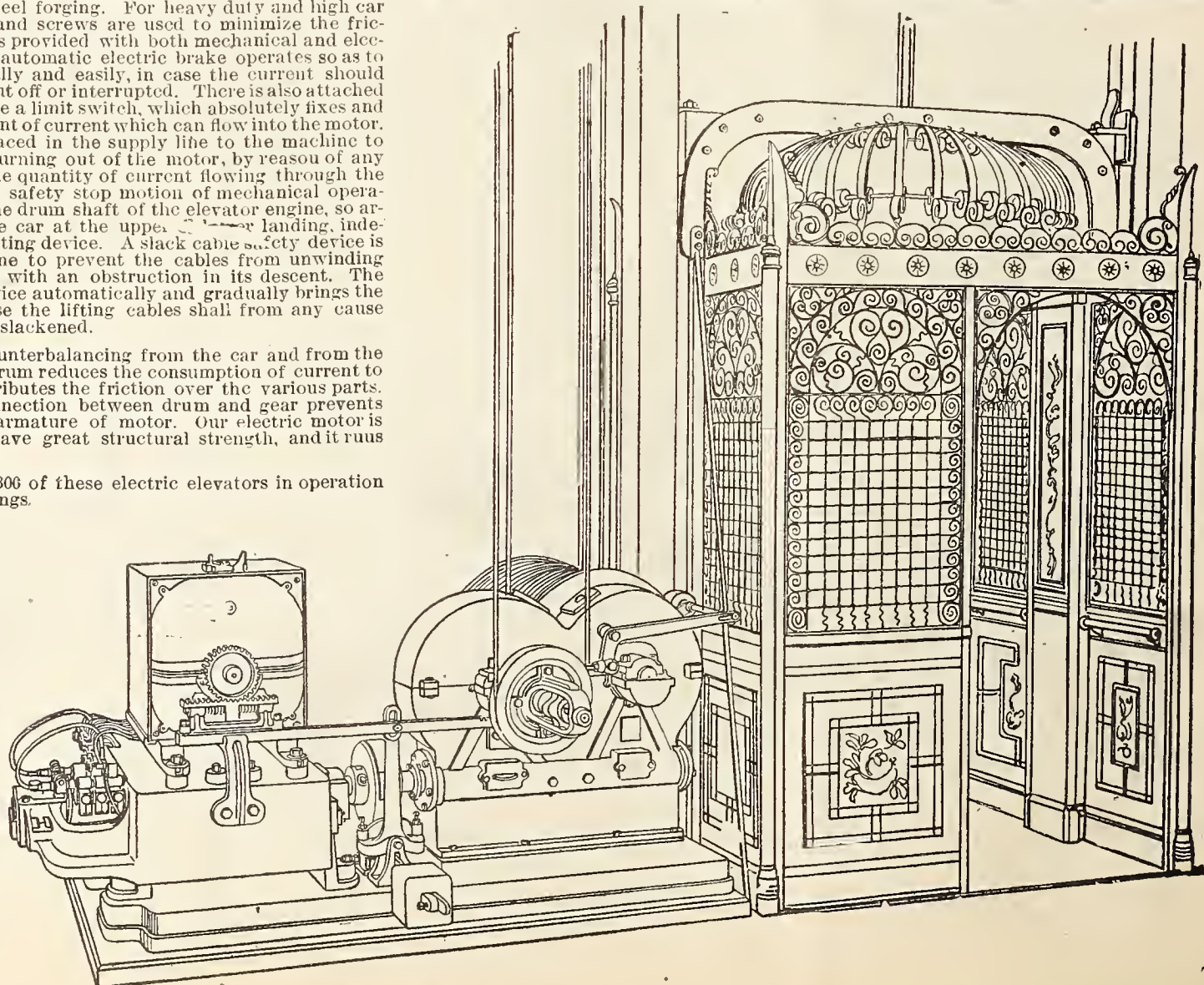
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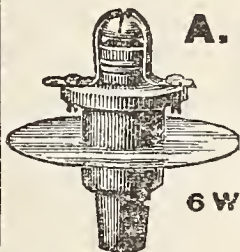


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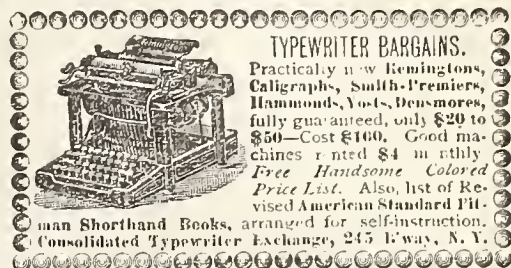
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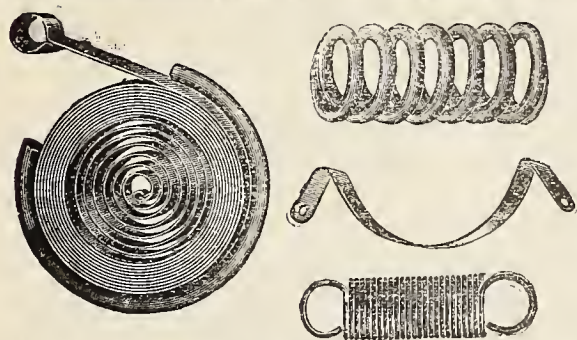
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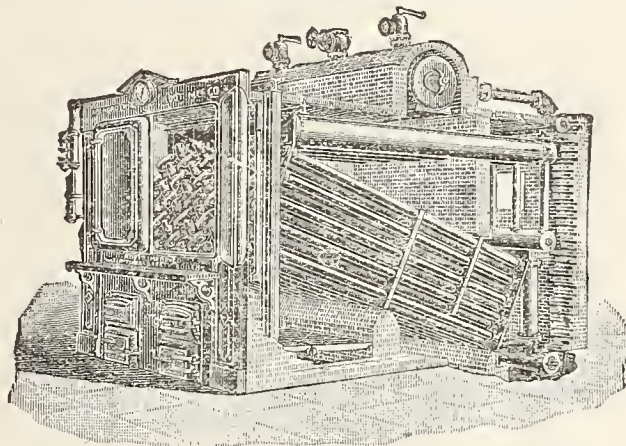
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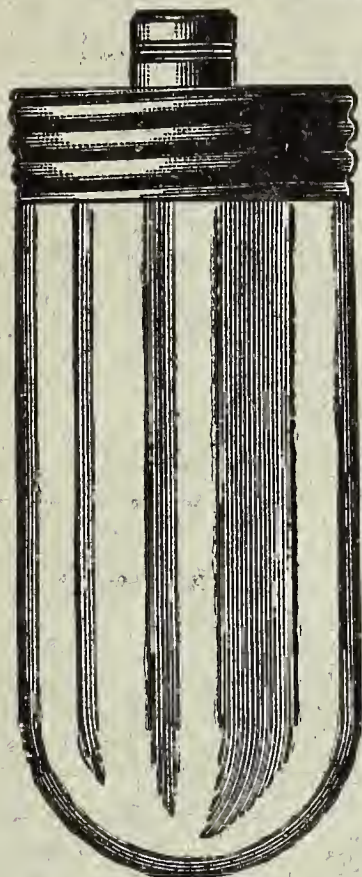
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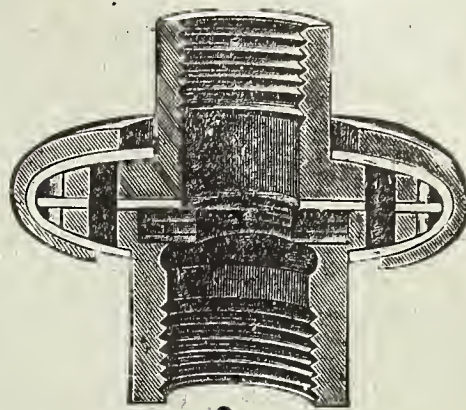
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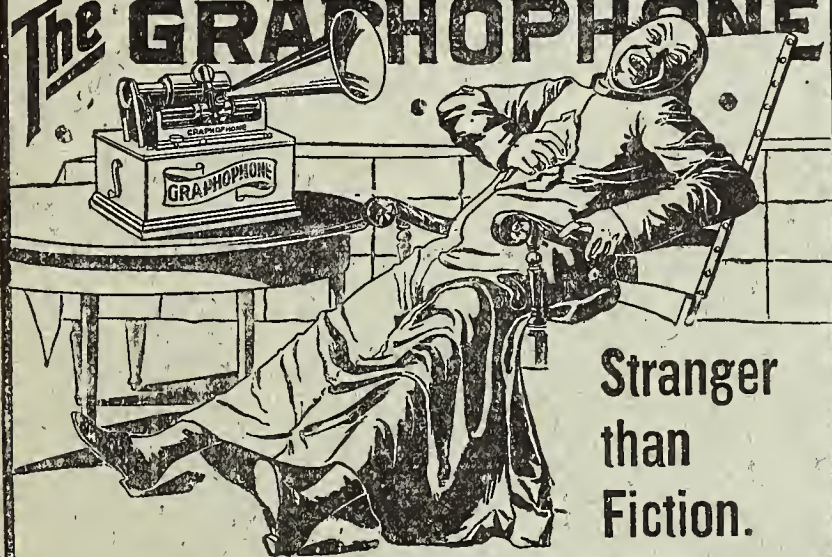


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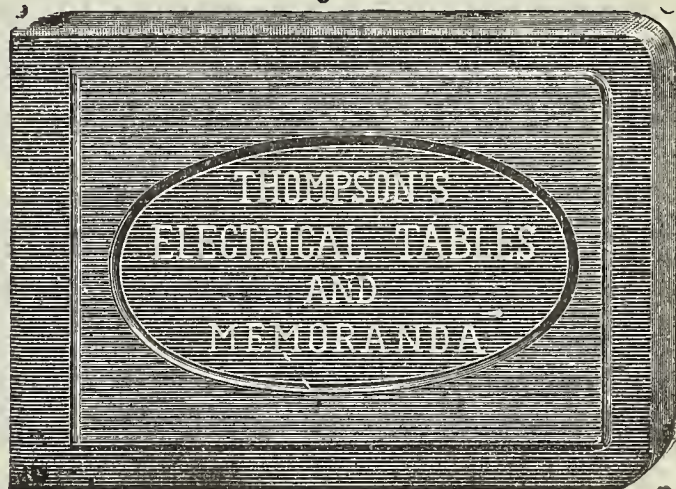
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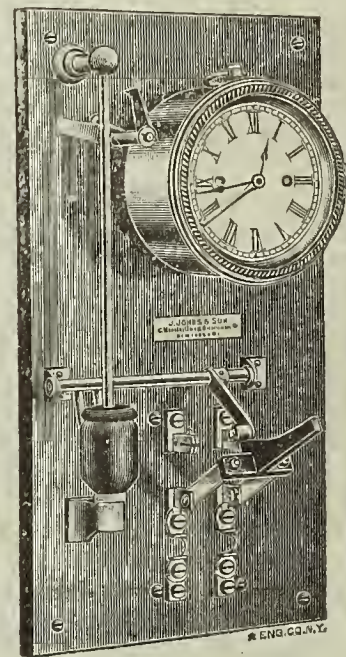
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